HNOLOGY DEPT.

The Chemical Age

OL LXV 22 SEPTEMBER 1951 No 1680

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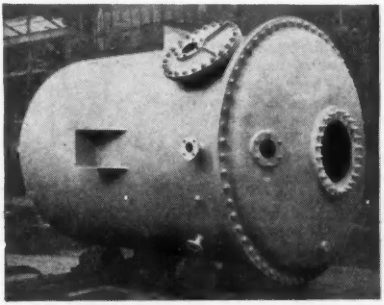

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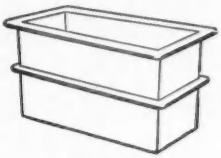

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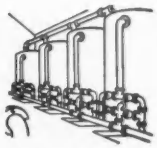

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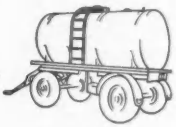

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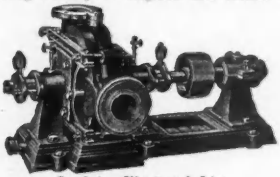

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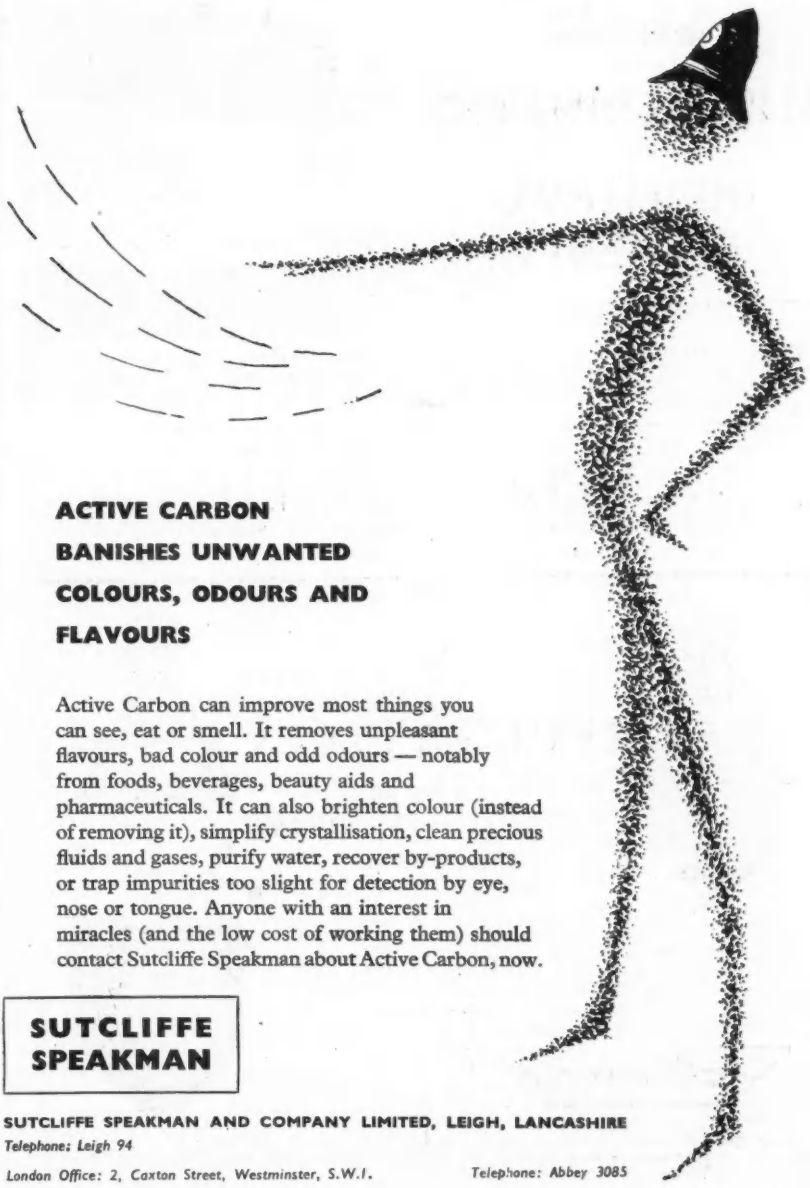

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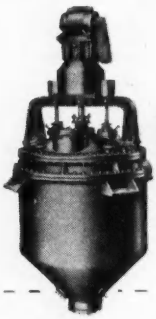

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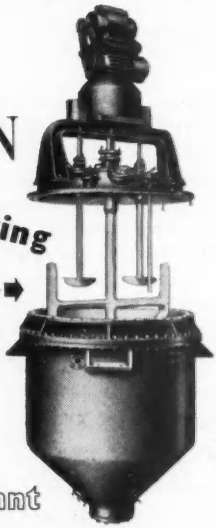

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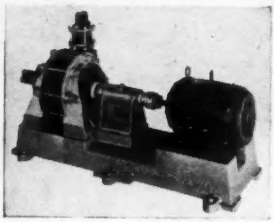

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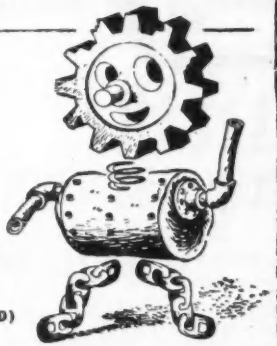

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Volume LXV 22 September 1951 Number 1680

Complex Simplicity

THE hard realities of industrial chemistry have rarely been better presented than in G. I. Higson's recently published paper (*Chemistry and Industry*, 8 September, 1951, pp. 750-754) on 'The Manufacture of Ammonium Sulphate from Anhydrite'. For new or approaching graduates in the universities it is doubtful whether any paper of the past twenty years could show so clearly the mighty differences between chemistry via text-books and test-tubes and chemistry 'by the hundred tons'. The reactions involved in the process are simple. Yet it is 'a fine example of how a simple chemical reaction needs all the resources of chemical engineering to make it practical on a large scale'. Ammonia gas into water; saturation with CO_2 to give ammonium carbonate; finally reaction with anhydrite ($CaSO_4$) and removal of precipitated $CaCO_3$.

All three reactions involved are exothermic. In operating the first two reactions on a large scale the heat produced must be disposed of steadily, particularly when the ammonia solution is carbonated. The third reaction is reversible and it cannot be taken to a reasonable extent of completion unless both carbon dioxide and ammonia are kept present in excess. This means that the carbonation of the ammonia solution must be slightly excessive, i.e., producing some bicarbonate. Yet if the heat of carbonation is not disposed of during the process the temperature of the solution rises to a point when carbonisation ceases. It is necessary, therefore, to design towers in which ammonia solution and carbon dioxide can flow in counter directions and from which the carbonated liquors can be withdrawn at intervals, then cooled and returned for further carbon dioxide absorption. Even this was not as simple as it might sound for at the temperatures reached the carbonated liquors are corrosive to cast iron, and this problem has required separate anti-corrosion research to enable the plant used to last.

The final reaction between the solid anhydrite and the ammonium carbonate solution has presented the biggest difficulties. Obviously, the practical rate and extent of the double decomposition requires the anhydrite to be finely divided so that intimate contact with the reacting liquid is easily achieved. But the finer the anhydrite particles, the finer also the particles of calcium carbonate that are produced; and the solution of ammonium sulphate must be filtered free of calcium

carbonate. A compromise has to be made, keeping the anhydrite's particle size coarse enough to yield a calcium carbonate ' mud ' which is easily filtered off. The 'system' must be kept constantly agitated and it reaches maximum practical completion in five hours. Any interruption in agitation leads to sedimentation and a highly ammoniacal mud must then be dug out of the vessel, no comfortable operation nor afterwards an easy waste disposal problem. Since the reaction is reversible the incoming flow of ammonium carbonate solution must not be diluted by residual and weak liquors; to avoid this, the reaction must be carried out not in one vessel, but in a series of four or five valve-controlled vessels.

The first stage of filtration gives a cake of calcium carbonate containing a considerable amount of ammonium sulphate. For effective yield in the process as a whole, this cake must be re-slurried with washings from the secondary filters. Further filtration recovers much of the ammonium sulphate though the final residue of chalk will still contain from 1 to 2 per cent of ammonium sulphate, an advantage if it is used as agricultural lime, a disadvantage if used for cement manufacture. The solution of ammonium sulphate must be freed from fine and residual particles of chalk. These are converted into calcium sulphate since the reaction is reversible; and the presence of calcium sulphate during the final evaporation stage gives rise to fresh problems. Tank settlement assists this, but not with complete efficiency. The excess ammonium carbonate and other gases must also be removed by heat treatment.

By then the solution of ammonium sulphate is highly corrosive. Plant for further handling must be made of specially resistant metals. Vacuum evaporation produces a saturated solution from which the ammonium sulphate steadily crystallises. However, mere crystallisation is no longer enough. Agricultural machines and the timetable of farming require sulphate of ammonia fertiliser to have a crystal size and shape suitable both for drilling and for storage without hard caking. Modern studies have shown that suitable crystal forms can be produced, but only by making the liquor even more corrosive to the evaporators. Here again a severe ' materials of construction ' problem has had to be solved by the chemical engineer!

Today two factories operating this process are producing more than 600,000 tons of sulphate of ammonia. How important that anhydrite process is can be realised more vividly now for the alternative reagent is sulphuric acid! Simple chemical reactions, but at the I.C.I. Billingham factory where the process has now been worked for more than twenty years finality of design has still not been reached. Higson's candid and stimulating account of the process should be thoroughly digested by every young chemist hoping to make a career in the industry. It provides an ideal example of the large-scale problems of basically simple reactions as well as the adventure and challenge of industrial chemistry.

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Notes & Comments

The Fawley Achievement

THE giant new Esso refinery at Fawley is of such great importance that it is almost impossible to grasp its full significance at the present moment. In the first place it is a large and extremely well-built refinery. Secondly, it marks a decisive stage in the expansion of Britain's oil-refining industry, for it is only the first of four already under construction. (By the end of 1952 it is estimated that the United Kingdom's refining capacity will have reached the 22,000,000 tons per year level compared with the 2,500,000 tons pre-war.) Thirdly, it will provide a significant saving in dollars ($2,000,000) and other currencies. Perhaps, however, Fawley's real importance lies in the fact that it is the largest single manifestation of American participation in Britain's post-war development programme and that its construction in such a short time is a result of perfect Anglo-American co-operation. Above all, it shows that the Americans have faith in the British and that the nationals of the two countries can and will work side by side in the common good.

A Happy Blend

WHILE two-thirds of the equipment and practically the whole of the labour force was British, it was American technicians who planned and supervised, and it was American capital which was used. Owing to the considerable differences in outlook, methods and temperament, one could reasonably expect that friction, jealousy and resentment might have arisen, but fortunately this has not been the case. As a matter of fact, there is plenty of evidence to show that the very best team-spirit prevailed. Members of the staffs of the Standard Oil Company and Foster Wheeler, Limited (the contractors), have been very generous with their praise of the British, and the British have been quick to acknowledge that the task would have been impossible without the leadership and knowledge of their friends from across the Atlantic. There can be no doubt, therefore, that the great transformation which has taken place at Fawley during the past two years will long stand as a monument to a particularly happy blend of American foresight, energy and technical knowledge and British craftsmanship and adaptability. The achievement of Fawley is real proof that both nations can benefit from a pooling of their particular talents.

Food Chemicals

THE joint conference of the Society of Chemical Industry's Food, Agriculture and Fine Chemicals Groups on problems that arise from the use of chemicals in food will be universally welcomed. All too often in the past scientists have remained silent and aloof when aspects of their work have become matters of public controversy. No one could deny that on this and the other side of the Atlantic there is a growing apprehension about the dangers of chemicals in food, of chemicals added during processing and of chemicals that are residual from cropping treatments. No doubt a good deal of this apprehension is artificial and exaggerated. In its everyday usage 'chemicals' has always been a portmanteau word of Jekyll and Hyde disposition and the presence of chemicals in foodstuffs is all too ready a subject for the sensationalist writer or speaker. Few editors of popular papers would spurn a headline like 'You Are Being Poisoned.' A little evidence or merely indications of evidence are enough for a violent indictment. Just one chemical found lacking in safety or safeguards is a good enough sample to put all food chemicals in the dock. By holding their conference at an early stage in the 'food chemicals' controversy, British scientists are wisely taking public opinion by the forelock.

Maximum Publicity

THE conference will be held at the Wellcome Research Institution, Euston Road, London, on 27 and 28 September. Twelve papers will be read at the four sessions and the chemical invasion of foods will be considered over

the widest possible range, from the use of preservatives, colouring agents, and improvers to the residues from crop sprays and from chemicals used to clean processing utensils. It is to be hoped that these proceedings will not be in secret or closed-shop session. Important though it is that chemists should discuss what are essentially chemical problems, it is even more important that the public should know not only that this is being done but also how conscientiously. This is a subject on which the public must be as fully informed as possible. The fact that it is highly technical means that professional scientists inevitably treble the parts of sinner, policeman, and judge. In a democracy there is only one safety-valve for such situations—maximum publicity, minimum secrecy.

Debate of Sulphur

OUR 'Note and Comment' item of 21 July ('A Better Press Needed') which appealed for a fairer presentation in the U.S. technical press of British efforts to overcome sulphur scarcity seems to have travelled farther and faster than we might have hoped. A Birmingham reader, Mr. R. L. Morecroft, wrote to one of the American journals whose comments we had critically examined and, as a result, our leader was substantially quoted in that journal's correspondence page (*Chemical Week*, 11 August, 1951, p. 4). Like *Chemical Week*, we are grateful to Mr. Morecroft for his direct action in bringing the two viewpoints together, and we express our thanks to *Chemical Week* for their handsome gesture in printing the letter. Controversy must always accelerate progress so long as discussions are not one-sided. As an earlier leader of ours will show ('Brimstone—Without Treacle,' 14 April, 1951) we have made special endeavours to present the American view of Britain's sulphur situation. We are fully aware that no export from the United States is more painful than that of sulphur and any delay or apathy here in efforts to reduce dependence upon American sulphur must be severely indicted. At the same time we have hoped that technical opinion in the United States would be kept fully informed of British efforts to save sulphur. With Mr. Morecroft's help these hopes have been realised. We have been glad to see in a further issue of *Chemical Week* (25 August, 1951, pp. 10-11) a lively and constructive account of British plans to reduce U.S. sulphur dependence, a news report obtained by cable from that journal's London Bureau. The more we understand and respect each other's internal problems the stronger will Anglo-American unity be. There are more than a few subjects on which there are sharp transatlantic differences in outlook. We do not believe that sulphur need be, or should be, one of those subjects.

Adaptable Aphorisms

EVERYTHING that has been done in this world of supreme benefit to mankind has been done by enthusiasts! A more fitting tribute to the first Lord Leverhulme than these, his own words, it would be hard to find. For William Hesketh Lever, the centenary of whose birth occurred this week, was a man of broad vision, high confidence, boundless energy, and a keenness which seems sadly lacking today in a welfare State which has done little except to infect an apathy into industry and commerce. W. H. Lever had a shrewd perception well ahead of most of his contemporaries and many of his aphorisms are eminently adaptable to present times. 'The progress of the world has gone on in spite of our British reluctance to take new departure.' Reports of productivity teams which have visited the U.S.A. under the Anglo-American Productivity Council have repeatedly emphasised the suspicion with which the British worker still regards innovations in methods and machinery. 'We have apparently taught our citizens to expect to get from Parliament by vote what citizens ought to obtain for themselves by work,' might well have been said about the welfare State. As an encouragement to the present drive for greater productivity two of Lord Leverhulme's sayings could hardly be bettered: 'You can only increase wealth by increasing production,' and 'Let both employer and employee scrap their old, antiquated, false, mistaken, and cramping ideas as to their relationship; they are in the same boat.'

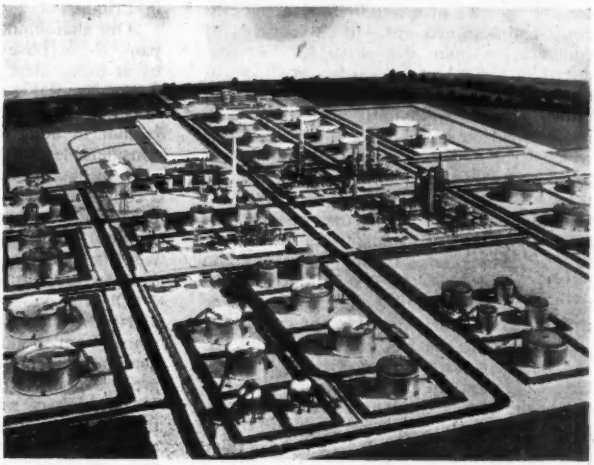
Prime Minister Opens Fawley

Europe's Largest Refinery; Great Anglo-American Achievement

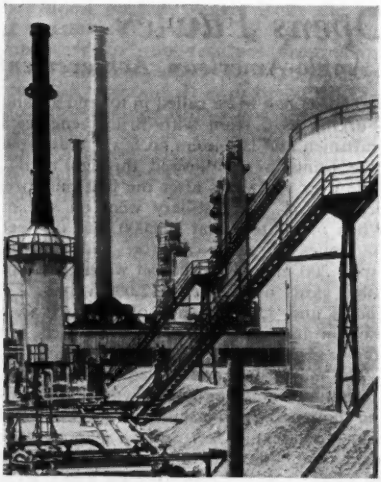
AN event of outstanding importance to Britain's economic and industrial welfare took place on Friday, 14 September, when the largest oil refinery in Europe (and one of the largest in the world), the £37,500,000 Esso plant at Fawley, Hampshire, was officially opened by the Prime Minister, Mr. Attlee. The refinery, which when in full operation, will produce 6,500,000 tons of petroleum products per year, has been completed in just over two years—four months ahead of schedule. Its construction in so short a time is a notable achievement and as the Prime Minister and other speakers said, is a great example of British and American co-operation. The vision, skill and energy of all those who helped to plan and build it—British and American—is deserving of the highest praise. The great assembly at the opening ceremony—numbering more than 6,000—was undoubtedly greatly impressed, almost awed, by the size, beauty and significance of the refinery.

Clearance of the 450-acre site began in July, 1949, and at the peak period of construction more than 5,000 men were working. As Britain has virtually no oil in the country and only a handful of British experts have had experience with refinery construction, 85 American engineers, supervisors and specialists had to be called in to lend a hand. Working as a team with British engineers, craftsmen and labourers no fewer than 6,000 blue prints were followed through until a little over two years after the first bulldozer began work, the distillery went on stream. When one is told that 100,000 tons of steel, 300 miles of steel, cast-iron and concrete pipes, 200 miles of electrical wiring, 100,000 cubic yards of concrete, 12,000 valves, 220 pumps and 1,600 pounds of mercury were used in its construction, it is realised just what a great feat it was.

The major units comprised two pipestills, a catalytic cracking plant with light ends and polymerisation facilities; an Edeleanu plant for treating kerosine, a hypochlorite plant and other treating and sweetening plants for petrol, lubricating oil and tractor fuels. Waste gases are carried away by means of three 250-foot high stacks. The dibutaniser tower weighs 135 tons, is 113 feet high and 12 feet in diameter while the giant 'cat-cracker' is fitted with a silencer to deaden the roar which would be caused by gases escaping at high velocity. It will consume 25 gallons of catalyst and produce 1,000,000 gallons of high quality petrol per hour. The maintenance building is the largest in Europe, being 800 feet long and



A view of the model of the refinery built to a scale of $\frac{1}{32}$ inch to a foot by three company employees for general exhibition purposes



The fuel oil heater of the boiler plant (left) and the single-stage and two-stage crude units.

180 feet wide and covering more than three acres. The administration building has 64,000 square feet of floor space and the medical department housed in it includes an emergency operating theatre. The project was so vast that a school of welders was established and an army of welders was trained in five or six weeks. An enormous cement-mixing plant 100 feet high was erected and turned out 140 cubic yards of concrete per hour and altogether has produced 100,000 cubic yards. A fleet of specially designed dump trucks carried the concrete to the site and the organisation made it possible for all the concrete which went into the catalytic cracking plant to be poured within 24 hours. A new marine terminal with a 3,200 feet jetty provides simultaneous berthing accommodation for four of the largest oil tankers as well as for smaller coastal tankers. For processing and cooling more than 4,250,000 gallons of water an hour will be used. There is storage capacity for 1,500,000 gallons of crude.

Presiding at the opening ceremony, Mr. L. Sinclair, chairman of Esso Petroleum Co., Ltd., said (in part):—

'At the end of the late war the oil industry in this country was certainly presented with a major problem. Briefly, it was this: how could we meet the nation's needs of over 20 million tons a year of petroleum products and, at the same time, drastically reduce the strain on our dollar resources? Upon the industry's ability to meet that challenge hinged the maintenance of basic living standards for our entire population.

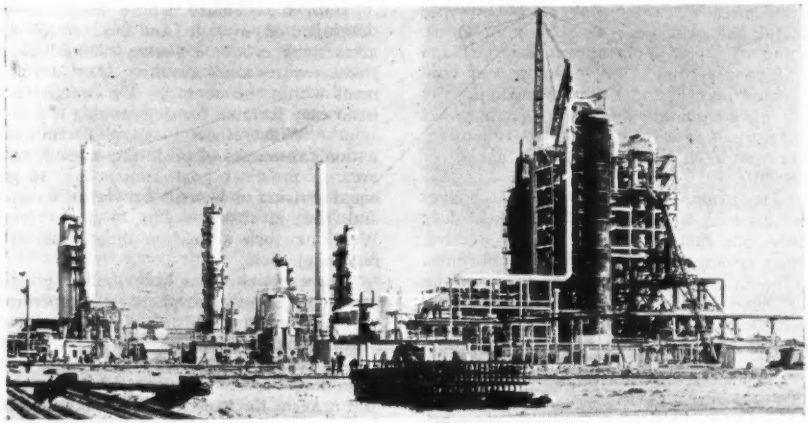
'All around us here to-day we can see the evidence of how we are helping to solve that problem. For out of this refinery alone will flow nearly a third of our present national needs for petroleum products. This will result in a saving in foreign exchange of more than 100 million dollars a year.

'Naturally enough the credit for this achievement belongs to a great many people. But to my mind it belongs primarily to some 5,000 British people who have worked here, whose loyalty and energy and enthusiasm has enabled us to bring this plant into production nearly four months ahead of schedule. I believe that not only our company, not only our country, but all the free nations of the world owe these men a debt of gratitude.

'I must also record our company's appreciation of the fine co-operation we have enjoyed throughout the construction period with the Government Ministries, the Trade Unions, the local authorities and with British suppliers of equipment. Bearing in mind the urgent nature of the task and the heavy demands imposed by the re-armament programme, I am sure you will be glad to know that well over two-thirds of the equipment used in this refinery bears the stamp 'Made in Britain'.

'Our shareholders, the Standard Oil Company (New Jersey) have been solidly with us at every step. They have placed freely at our disposal the expert knowledge of their best technicians, and what is very important is that in addition to the reinvestment of considerable funds they have provided a very substantial amount of new capital. As a consequence, we have not had to call upon ECA or any other outside source, for funds of any kind. This investment is, in my view, a tangible expression of American faith in the future of the British nation.

'On a previous visit the Minister of Fuel and Power, the Rt. Hon. Philip Noel-Baker, whom I am so glad to see here again to-day, generously referred to this project as "a great British-American co-operative effort" I can think of no better phrase to sum up the spirit in which this huge plant has actually arisen from virgin soil in a little over two years.



A general view of the main refinery units

'Those of you who are motorists will, I am sure, be particularly glad to hear that the refinery's output of 5¼ million gallons a day will include over a million and a half gallons a day of petrol.

'You may also be interested to hear that we are now proceeding with new equipment for the annual production of 12,000 tons of sulphur from crude petroleum. This output will make an important contribution to meet the national requirements of this vital raw material. In particular, it will help to ensure stable production and employment in our great textile industries.

'It may not be out of place to mention here that we shall provide in this plant regular employment and a reasonable standard of living for some 2,500 local people.

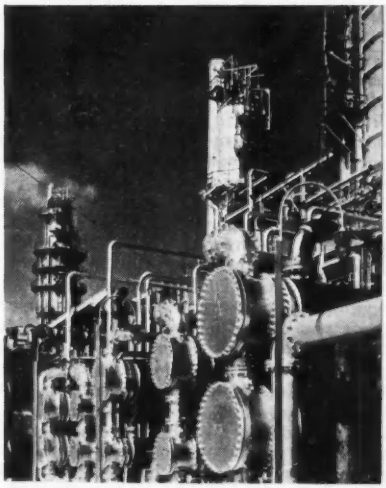
'I cannot let this occasion go by without paying a very warm tribute to my predecessor, the late Mr. R. A. Carder. His interest and enthusiasm for the project and his encouragement for all who worked on it, played a very important part in its progress.

'Before I call upon the Prime Minister to perform the task I want to introduce to you a colleague whose interest in this refinery is such that he has travelled over 3000 miles to be with us on this occasion.

'His name is Mr. Frank Abrams, chairman of the board of directors of the Standard Oil Company (New Jersey). In the field of international oil affairs I doubt very much whether any one man possesses more specialised experience and knowledge. But perhaps even more to the point is the fact that to those of us who know him he has endeared himself as a man of exceptional warmth and sincerity of purpose, and above all as a true friend of the British people'.

Briefly, Mr. Abrams' address was as follows:—

'These steel columns and pipework, much



The single-stage crude unit (left) and the two-stage crude unit with heat exchangers in the foreground

of it already turning raw petroleum into useful products, rose here by joint effort. Some of this equipment was designed and built in my country. Even more was constructed here in the United Kingdom. The job of getting all the parts together, left largely to the skill of British craftsmanship, has now been finished—months ahead of schedule.

'The plant takes from the soil but gives nothing back to it. A good investment does more than that. Not only is it productive, but it enriches the soil itself—it contributes to the economic strength of the nation where the investment is made. And good investments benefit not only the direct participants but also the many others who are served.

Real Co-operation

'There are people who have the notion that if one party gains in commercial transactions the other party has surely sustained loss. We have quite the opposite idea. Real international co-operation in our judgment can exist only when both parties give and both gain. In doing this they enlarge the well-being of each. That is what we expect this refinery at Fawley to do. We are hopeful it will produce for the British people and for Americans far more than each of us has put into it.

'When different people co-operate to develop an enterprise, it should be run so as to help build up the domestic economy of the country where it is located. Nationals of the country concerned should have the opportunity to be trained and employed at fair rates of pay in progressively more responsible assignments. The products turned out by the business should be sold at reasonable prices. They should be available for use in the country where they are produced as well as for export. Where natural resources are involved, these should be developed efficiently and without waste.

'People in a land which provides the opportunity for investment have rights which merit respect. Similarly, rights which are important to those making the investment and taking the risks also deserve consideration. My own company's viewpoint is that in all countries in which we operate we should be able to rely on mutual respect for the title to property we have acquired or which has been produced by our talents and labour. Furthermore, to employ effectively our skill and facilities, we need managerial control of our business.

'Both the country whose resources are developed or employed and the investor who gives them economic value, should fairly share any revenues resulting from development within the country. Of course, there is no easy formula for determining this division. With respect to development of a nation's resources of oil in the ground, however, a practical goal—amounting to an equal division of benefits between the nation and the investors—seems to be evolving. We think such a goal in these cases is a reasonable one.

'Our experience has been that progress is best made in an atmosphere of competition. Several companies—distributing risks and all contributing, each in its own way, to the accumulation of knowledge and experience—produce the best results. When competition is keen, the exercise of keeping up with it sharpens wits and strengthens muscles. In the struggle to achieve, companies become stronger and more efficient. Consumers profit thereby. For the essence of competition is the creation of new opportunities.

'We believe the elements of sound, creative international investment are present in this great refinery. In these changing times Fawley does much to strengthen my spirit. This refinery is a concrete example of the kind of constructive effort which shows we have faith in the future and in each other. You may be sure that Esso Petroleum Company and Standard Oil Company (New Jersey) will make every effort to see that this refinery fulfils the hopes that you and we both have for it'.

Mr. Attlee's Address

The following is an abbreviated version of the speech given by the Prime Minister:

'You, Mr. Chairman, have served the Company for forty-three years. It must be a proud day for you when you see this great venture brought to fruition though, like all of us, you will regret that your predecessor, Mr. Carder, who saw the initiation of the scheme did not live to see its completion. We are glad to see here Mr. Abrams, the chairman of the Standard Oil Company of New Jersey, the parent company of Esso and the biggest oil business in the world, with a number of his colleagues. It is a happy thing too that we have representatives of the contractors who built Fawley refinery and the workers of whose skill and energy it is a monument, and also of those who will be engaged in its activities.

'Before the war oil refineries were built as near as possible to the sources of crude oil and refined products were shipped to their markets. In recent years the policy has changed and companies are building their big refineries near to their markets. There are some disadvantages but the advantages outweigh them. For instance different sources of crude oil can be used and petroleum chemical industries can be developed using the gases and by-products produced in the refining process.

'The Government have been glad to encourage this policy. Before the war only two and a half million tons of petroleum products were produced here. Soon the United Kingdom refineries will produce twenty million tons.

'One of the benefits of the Fawley refinery will be that it has a plant for making use of the sulphur which is a nuisance in petroleum but a necessity for many industrial processes. The supply of sulphur has, as is generally known, been causing us some anxiety and the twelve thousand tons which it is hoped will be produced at Fawley will make a useful contribution to our supplies.

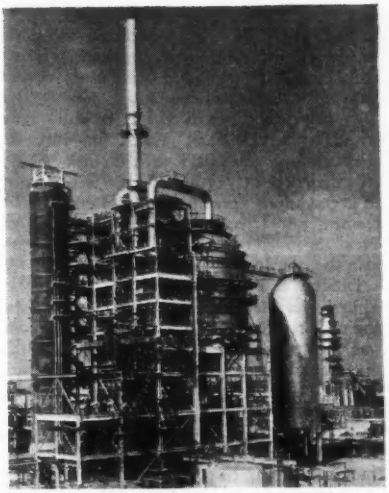
'But of greater importance is the contribution which Fawley will make to the solution of our balance of payments problem. When the cost of refining arises in this country, it is obvious that there is a great saving of foreign currency, especially dollars.

Reducing the Burden

'The project has, in fact, played a major part in last year's negotiations on the dollar-sterling oil question which led to an agreement between the Government and the New Jersey and other companies. It is a good thing for both the United States and ourselves that we should compete in the sterling area, but the very heavy dollar bill which we have to incur for oil made it necessary for us to seek all means of reducing it.

'As far as the New Jersey Company was concerned one of the main reasons making it possible to reach an amicable agreement was the fact that the Fawley refinery would make a substantial reduction in the dollar cost of their oil.

'The Fawley enterprise is a great example of British and American co-operation. This applies not merely in the field of policy but in that of execution. All who have been concerned, technicians, draughtsmen, foremen, metal workers, craftsmen and labourers, can take pride in their achievement.



The catalytic cracking plant which will produce a million gallons of motor spirit a day

Other big plants have been built up over the years stage by stage, but Fawley is the biggest single constructional refinery job ever undertaken. Begun only in 1949 this main stage has been completed nearly half a year ahead of schedule. American technicians and foremen have planned the refinery and supervised the construction, but the labour employed has been nearly all local and many of the leading firms have worked as subcontractors.

'Much of the equipment, indeed nearly two-thirds, has come from this country, much more than was anticipated and this is a tribute to the engineering skill of this old country.

'The British companies have set up a Committee called the Oil Supplies Advisory Committee to advise the Government and there is a similar Committee of the United States Companies called the Foreign Petroleum Supplies Committee. These two committees have established very close relations and their co-operation has been fruitful. So far they have been dealing with the situation during the remainder of 1951. You will be glad to know that supplies of motor spirit, sufficient to replace those normally exported from Abadan, have been guaranteed up to the end of 1951 and while there will be a

deficiency in some products it will not be large. There is every reason to think that the position in 1952 will show an improvement as there will have been more time to develop alternative supplies.

'I hope that this fact will be duly noted by all those Persians (and I am sure that they are the majority) who do not wish to see their country ruined. We are anxious to come to an agreement with Persia and to resume our friendly co-operation but the Persians must realise that a long delay may lose the market for Persian oil'.

During a Press tour of the refinery on Thursday, Mr. Luther Martin, the staff engineer for Standard Oil Development, who was in charge of the construction, said that the second phase of the scheme was ahead of schedule and that it was hoped that additional facilities planned would be completed by the dates laid down in the original plan. These include plant for the production of tractor fuel (to be completed by February, 1953), the sulphur recovery plant (1 April, 1953) and lubricating oils facilities (1 August, 1953).

Tinplate Substitute Claim

A SUBSTITUTE for tinplate is reported from America, which it is claimed can be produced at a competitive price, or in many cases 'actually cheaper' than tinplate itself.

Announcement of the substitute which, if its claims are justified may well have repercussions throughout the world tin market, and which may prove of importance to the defence production programme, was made in Washington last week by Mr. Stuart Symington, new head of the Reconstruction Finance Corporation.

The developing company, Reynolds Metals, has not yet been able to secure a patent on the process and had not yet intended it to be publicised, according to its vice-chairman, Mr. J. Lewis Reynolds, in charge of operations at the company's plant at Richmond, Virginia.

Opportunity to reveal the new substitute seems however to have been seized upon by Mr. Symington who declared that it was ready for production, but first supplies would be restricted for use by the armed forces.

Description of the Reynolds process was reported in the *Financial Times* as follows:

A roll of aluminium plate is coated with plastic continuously at high speed and, in the process, may be colour printed. The plastics that may be used include vinyls, polyethylenes and polyvinyl chloride. The coil is then heated to a prescribed temperature and the two thicknesses are rolled on a tube or mandril under pressure. This becomes the body of the container.

The Reynolds company has another tin-substitute process, described as 'aluminised steel'. It involves the welding of an inner and outer coat of aluminium foil to steel sheet. This is done by using three rolls—two of foil and one of pre-heated steel sheet—which are fed through a rolling mill and sandwiched together.

No Synthetic Rubber Plant

ANY suggestion that the Government intended to build a synthetic rubber plant adjacent to the £37.5 million refinery of the Esso Petroleum Company at Fawley, near Southampton, has been officially denied.

No approach had been made by the Government to the Standard Oil Company, of New Jersey, of which Esso is a subsidiary, it was said. A spokesman for the petroleum company said there was no foundation for a newspaper report which had indicated that any surplus of dollars left after the construction of the refinery would be used to build a rubber plant.

It was also pointed out by rubber traders that if the construction of a rubber plant was being considered at Fawley, it was more likely to be for the production of butyl rubber than general purpose synthetic.

The question of making synthetic rubber for general use by U.K. manufacturers had been under review for some time, as at the present only small plants existed to produce for research purposes.

Anglo-Indian Glass-Making Project

A scheme for a British firm of glass manufacturers to help industrialists in India in the establishment of a new glass works near Calcutta has been announced. Pilkington Brothers, Ltd., of St. Helens, and the Hindusthan Development Corporation, Ltd., have formed a new company, Hindusthan-Pilkington Glass Works, Ltd., with capital of £750,000, to build a factory at Asansol. The British firm is to supervise the construction and give technical assistance for 20 years. It is hoped to be able to start production early in 1953.

Controllability & Plant Design

Part II—Practical Considerations

by Leo Walter, A.M.I.Mech.E., Consulting Engineer

IT should be of interest to the designer and plant engineer alike to learn how many design and operating factors can influence the controllability of heat flow processes. Taking again our steam heated calorifier (as typical for a great number of coil- or jacket-heated process vessels), Fig. 1 shows that various 'process time lags' develop during the flow of heat. These time lags have a definite influence on accuracy of control.

For instance, the heat entering the calorifier in the form of steam emerges first as a 'latent heat of condensation' within the heating coil. It then has to penetrate the coil walls and films of sediment of air or gases adherent to either side of the coil, and distribute itself throughout the water to heat it up. Finally it has to reach the thermostat bulb to make it react to temperature changes.

This heat flow meets various obstacles, causing delays which are conveniently called process time lags. The longer a change in temperature of the outflow water takes to reach the thermostat bulb, the longer the change in process temperature remains uncontrolled, and the longer it takes to re-establish the heat balance between the demand and supply of heat. Controllability can, therefore, be greatly improved by cutting down process time lags, and this can be done to some extent by the designer.

There are several methods of improving the controllability of the steam-heated hot water supply calorifier, in addition to providing for a big hot water storage volume.

(a) The ratio of heat capacities can be improved by using a coil of smaller diameter, but having the same heating surface, *i.e.*, using a 1 in. instead of 2 in. diameter coil, thus reducing its steam content. If this is not done, excess steam in the coil condenses after the steam has been shut off at the control temperature, and continues to heat the water.

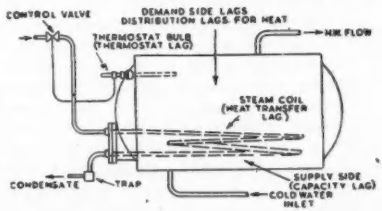


Fig. 1—The lags influence controllability of hot water supply calorifier

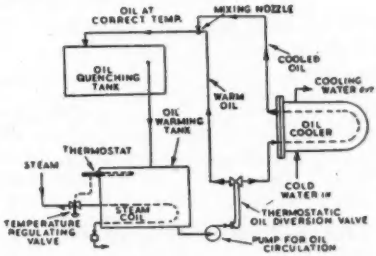


Fig. 2—Oil circulation and controlled oil cooling of oil quenching tank

(b) It is better to use the best conductor of heat available for the coil, *i.e.*, copper instead of iron.

(c) The heat distribution lag can be reduced by baffling, good circulation of the water, etc.

(d) Air and gas film on the coil can be reduced by air venting.

(e) Condensate should be properly drained from the coil, thus avoiding waterlogging with consequent disturbed and prolonged heat transfer.

For liquid heating in process vessels, other means are available for improving controllability. A mechanical stirrer reduces heat distribution lag. Using compressed air or pump circulation eliminates steam as a stirring medium, *i.e.*, in dye vats. It is, however, possible and sometimes advisable to recirculate steam in a process vessel where stagnant steam reduces the heat transfer.

An example where pump circulation of oil, and the use of a thermostatic diversion valve improves process efficiency and controllability is shown in Fig. 2. The valve automatically by-passes oil partly or completely through the oil cooler of an oil

quenching tank, according to oil temperature. A self-actuated thermostat controls steam admission to the oil heating tank, and a pump is used for circulation, which also improves the controllability. Incidentally, the specific heat of oil is only 50 per cent of water, and oil reacts, therefore, very much quicker to a change in the heat input of the steam heating coil than water. Oil as a cooling or heating medium is, therefore, much more controllable than water.

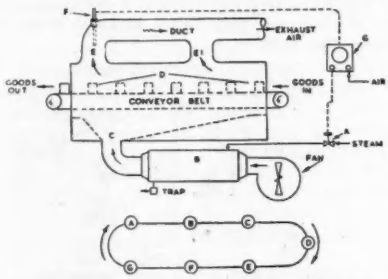


Fig. 3—Total lag cycle (closed loop)

Hot Air Driers:—It is not intended here to advise professional designers of hot air driers how to design their apparatus. It often happens, however, that old hot air driers needing improvement are redesigned by the user, or that a drying room is designed in the drawing office of a manufacturer without specialised experience, and it is these that it is desired to help.

Hot air drying is usually a two or three-capacity heat flow process, *i.e.*, heat is transferred from a heating medium through two or three intermediaries to the processed goods. The total controllability, therefore, as shown diagrammatically in Fig. 3, depends on the controllability of each heat transfer, and the time lags affecting them. First the deficiencies in the flow of heat will be considered, and then the deficiencies and time lags in the instruments employed.

In the illustration, a fan draws air in, which is heated in a multitubular air heater B. It is the job of the designer to make the heat transfer from steam *via* the heating tubes to the air as easy and as controllable as possible by choosing copper tubes of correct diameter and length, by correct trapping and air venting of the steam space, and by choosing the right air velocity over the tube surfaces. The hot air enters the drier at C, and passes over the material D (to be dried) through the wire mesh conveyor belt. The used air is then exhausted *via* exhaust ducts E and E_1, preferably by an exhaust fan controlled by an air damper. The process cycle so far is A-B-C-D-E, and it should be emphasised that all the way process time lags are present in transmitting heat from steam to the goods to be dried.

Assuming good controllability of the steam-air heater B, process time lags can be reduced by various means. The designer has to choose the correct air volume and speed, and good heat distribution within the drying space; for example by baffling the hot air, or by zone heating, etc. Efficiency and controllability can be further improved by recirculation of part of the exhaust air (not shown), and humidity can be controlled by re-heating this re-circulated air, and automatically mixing it with fresh inlet air.

Below the drier diagram, the 'closed loop', or control cycle is shown, illustrating not only the various process factors A to E, which influence controllability, but also the working elements of the pneumatic temperature controller, namely, the thermostat bulb F in exhaust duct E, the control mechanism G, and the steam control valve A in the steam supply pipe to the air heater.

Keeping Lags Low

F, G and A each cause instrument time lag, again consisting of delays in the working of the thermostat controller. It is the job of the instrument designer to keep these instrument time lags low, thus producing a very responsive control action, and it is therefore the job of the drier designer to see that any change in rate of heat input at A is transmitted as quickly as possible to D (the material). Correct location of the thermostat bulb F will then produce quick control action in case of the heat balance being disturbed, for example if more goods enter the drier per minute.

A branch of industry where the designer is continuously confronted with control problems, sometimes of great magnitude, is the chemical industry. The use of automatic controls in chemical plant, at one time purely a matter of discretion and frequently misunderstood and misapplied, often resulted in the early days in plant failure. Sometimes control instruments were not suitable, sometimes the plant design was not sufficiently controllable to produce close

control. The designer of chemical reaction vessels of all kinds, stills, columns, evaporators, digestors, ovens, mixers and separators, etc., had to learn a lot, partly from practical experience, partly from a study of the fundamentals of process control theory, how to design and redesign plant equipment in order to meet the requirements of automatic control.

Similarly the instrument designers had to produce better, more responsive but nevertheless accurate control instruments. Today, the term 'controllability' of a chemical process is common parlance with experienced and progressive designers of chemical plant equipment. Nevertheless, control problems often creep up unexpectedly; for example, where changes in working conditions or in the design of a single piece of equipment disturb the equilibrium of processing. On the other hand, minor changes in the working conditions of chemical plant and/or of the design of an older piece of plant equipment can often greatly improve the controllability of the chemical process as a whole. For the knowledgeable designer who co-operates with a control expert, there are many 'tricks' in plant layout and design for improving control. Exchange of the inlet and outlet points of a heat exchanger; the splitting up of a cooling coil and the re-locating of the two sections; the addition of a fan to a drier; the fitting of a more accurate pressure regulator into a steam supply pipe; the installing of a circulation pump; are some of them.

Controllability in Food Industry

Another branch of industry where controllability is most important is the food industry. Here, similar considerations apply as in chemical manufacture. It is often freely admitted that until a few years before the war, the accepted practice in the design of food plant, with very few exceptions, was to consider the automatic control of pressure, temperature, rate of flow, liquid level, *p*H, density, specific gravity, etc., as one of the last steps. More often than not, food plant equipment was delivered to the user without any means of automatic control. If at a later date the user wanted automatic control instruments fitted, an analysis of the food plant equipment then disclosed its bad controllability, thus either forcing the food manufacturer to go on using costly and unreliable hand control, or to install very elaborate control instruments at very high installation cost, and with not such good control results.

Later it became apparent to the designers and users of food plant machinery alike that merely attaching control instruments to the plant had many disadvantages, the main one being that it produced difficulties in food processing due to unsatisfactory control, and both users of food plant and makers of control instruments pressed the designers to improve the controllability of new plant designs. The modern trend is fortunately to work measuring and controlling instruments into the design of novel food plant at an early stage of development.

Adaptability Difficult

Some types of older machinery, however, do still prove difficult to modernise, because they are less controllable. Examples are, among others, quick-boiling pans with a bad ratio between steam coil volume and the mass of the heated substance; chocolate enrobbers, plate heaters or coolers, bakery ovens; food driers (spray and roller types), stills, and many other older types of plant.

Control of Mass Production: Mass production of goods usually involves either continuous manufacturing processes, or, on a larger scale, a number of batch processes. The use of efficient and easily controllable plant equipment here is of the utmost importance for increased output. A few examples may illustrate what the designer has to consider when making out new plant layouts.

Most engineer designers know the usual plating vat, consisting of a tank which is sometimes gas heated, sometimes heated by a water jacket or by steam or hot water coils. Controllability of the older types is often low, but modern still vats lend themselves better to thermostatic heating—and sometimes, also, cooling. The big problem of controllability turned up on the designer's doorstep once the demand from modern mass production of plated metal machine components for fully automatic plating plants became urgent. The control problems confronting the designer were (a) continuous transport of the material with a controlled immersion time in each bath, (b) temperature control of the plating and rinsing liquors, etc. (c) control of the *p*H of the baths, (d) control of the thickness of the layer of metal, and others. Space does not allow us to deal in detail with all developments that have taken place, but Fig. 4,

illustrates an automatic plating machine which is certainly a credit to its designers. Pneumatic or electric automatic controllers are applied here, and the controllability of the plant is of course excellent, having been considered right from the drawing board stage.

The use of photocells in mass production to stop a conveyor in case of irregularities of shape or colour of goods transported on a conveyor band has become widespread. One safety stop layout consists of a photocell transmitter unit which projects a light beam over the moving conveyor at right angles to its movement, with a receiver on the other side and a relay mechanism for stopping the conveyor motor. When applied to newly designed conveyors, the stopping problem is usually not difficult, but existing conveyor systems that have been designed without considering this safety gadget (probably not invented at the time) can be difficult. The same applies to many textile machines which did not allow for the possible installation of automatic speed control, as for example in Fig. 5, a control system popular in America for modern tape frame sizing machines (or 'slashers' as they are called in America). These are part of the textile finishing process.

In yarn sizing, which is performed on these machines, it is important that the yarn leaves the equipment with a certain fixed moisture content, leaving only the desired amount of moisture to be regained from the air. This hygroscopic quality can be achieved by controlling the speed of travel of the yarn in relation to its moisture content when it leaves the tape frame machine. In modern automatic control a detector roll "feels" the electrical conductivity of the yarn, and after amplification of these signals, a moisture recorder-controller actuates a control motor, which in turn adjusts a variable speed box coupled to the drive of the machine. The automatic speed variation of gear trains in process machinery can be achieved similarly, and various methods have been developed for adjusting them such as lever motors or power cylinders which are regulated by temperature, humidity, and/or speed.

One of the most highly developed branches of industry with regard to controllability is the oil industry. Designers of modern fractionating columns, for example, base their design on controllability to a very great extent, as do designers of a great variety of chemical plants. As an example of what 'engineered control' means for fractionating column control, a few control instruments which have to provide co-ordinated control actions in the distillation of petroleum products will be described.

From inflow of the crude oil into the feed tank, until the bottom product is drawn from the re-boiler, each piece of plant equipment is designed for good controllability. Control instruments used are a liquid-level controller for the feed accumulator, a flow regulator for controlling the rate of inlet flow into the column, cooling water control

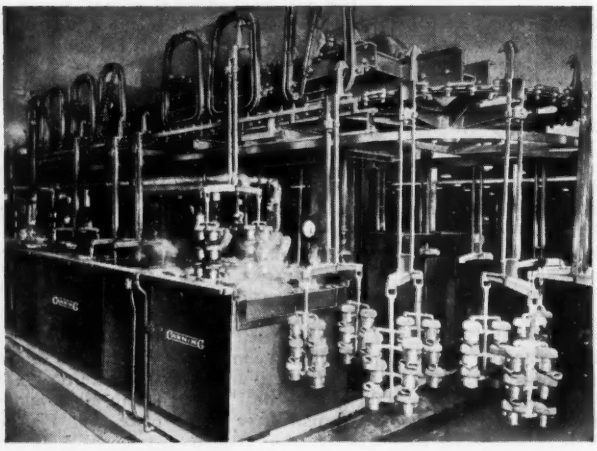


Fig. 4—Continuous plating machine

(Courtesy W. Cummings & Co., Ltd., Birmingham)

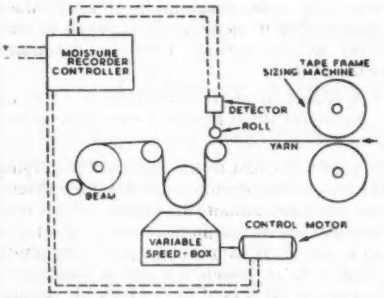


Fig. 5—Speed control according to yarn moisture content

for the reflux condenser, together with a level controller for the reflux accumulator.

Furthermore, flow of reflux to the column from the accumulator is controlled, and so is the reboiler temperature and liquid level. The very specialised designers of chemical plants of this and of other types work in closest co-operation with the control specialists, and by this team work close control and fully automatic working of the plant can be achieved.

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Leo Walter : Special Considerations for the Designer in Automatic Process Control. *The Chemical Age*. 17 April, 1949.

Copper Prices Reduced

REDUCTION in the price of electrolytic copper by £7 to £227 a long ton delivered consumers' works was announced by the Ministry of Materials as from 13 September.

This reduction was made possible by the Ministry's decision not to buy copper for the time being at prices exceeding the American f.a.s. export price as quoted in the *Engineering and Mining Journal*.

Discounts, premiums on special shapes and the limitations on forward purchasing arrangements announced by the Ministry of Supply on 1 May, 1951, remain unaltered.

The Ministry of Materials' buying price for rough copper in slabs of from two to three cwt. remains unchanged.

Corresponding adjustments in the controlled maximum prices of scrap and unwrought brass effective from the same date have been ordered by the Ministry of Supply as follows:

All descriptions of copper scrap, £7; 80/20 cupro-nickel scrap, all descriptions of gunmetal scrap, and gilding metal scrap, £6; scrap QF and SAA cases, and brass cuttings, 70/30 cupro-nickel scrap, 65/35 and 70/30 casting quality brass ingots, etc., and 70/30 brass strip ingot for rolling, £5; brass ingots, ets., to BSS 218 or 249, 63/37 strip ingot for rolling and brassrod and fuze scrap, brass swarf and heavy brass scrap, £4.

The Order, the Non-Ferrous Metals Prices (No. 7) Order S.I. No. 1650 may be obtained from HMSO.

Research Appointments

THREE fresh appointments to the membership of the National Research Development Corporation were announced by Sir Hartley Shawcross, President of the Board of Trade on 13 September, when those members whose initial period of service recently expired were also re-appointed.

New members are: Sir Henry Tizard, F.R.S., chairman of the Advisory Council on Scientific Policy, and the Defence Research Policy Committee; Sir Rowland Smith, chairman of the Ford Motor Co.; and Mr. J. F. Lockwood, managing director of Henry Simon, Ltd.

Re-appointed members are: Sir Percy Mills (chairman), Lord Halsbury (managing director), Professor P. M. S. Blackett, F.R.S., Professor E. C. Dodds, F.R.S., Sir John McL. Duncanson, Sir Edward H. Hodgson, Mr. W. E. P. Johnson, and Sir Edward de Stein.

The corporation was set up by the Government in 1949 to exploit and develop inventions in the public interest.

Arsenic in Foods

Some Modifications Recommended

RECOMMENDATIONS made by the Metallic Contamination Sub-Committee of the Food Standards Committee for modification of the limits for the arsenical contamination of foods proposed in its report of 26 May, 1949, have now been issued in a supplementary report. These alterations of the original proposals have been made as a result of a review of representations, supported in some cases by oral evidence, from trade and other interests.

Limits Unchanged

Limits previously recommended for beverages ready-to-drink, that is 0.1 parts per million, and for all other foods, whether solid or liquid, not otherwise specified, that is 1.0 p.p.m., are unchanged.

Modifications proposed, which mainly affect foods, are as follows:—

Regard has been had to the contention that arsenic content of beverage bases (i.e., substances used as the basis for the preparation of beverages) is not directly related to the total solids content—particularly in the case of products used in the preparation of soft drinks. The item 'beverage base' has, therefore, been deleted from the Schedule and for 'concentrates' used in the preparation of soft drinks a limit of 0.5 p.p.m. is recommended. The general limit of 0.1 p.p.m. for beverages ready-to-drink applies to all beverages except cider and soft drinks intended for consumption after dilution, for which the limits proposed are 0.2 and 0.5 p.p.m. respectively.

The higher limit for cider is only justified while it remains the practice to spray fruit with lead arsenate, and it is considered that the position in this respect should be reviewed periodically.

Special Allowance

A limit of 5 p.p.m. on the dry colouring matter is recommended only for cochineal and other natural dyes, 'synthetic' colours being required to conform to the general limit.

Difficulty in restricting the arsenic content of hop concentrates, finings and clearings agents to the limit of 2 p.p.m. recommended for dried hops has been recognised by increasing the limit for these substances. It should be emphasised that the beer or other beverage, in the preparation of which these ingredients are used, is still required to conform to the general limit for beverages ready-to-drink.

A reduction in the limit from 5 p.p.m. to 2 p.p.m. for dried liquorice extract is recommended.

Arsenic content of the fuel used for drying chicory is outside the control of the driers; and since the amount of arsenic which may be conveyed to the final beverage is only a very small fraction of that in the dried chicory it is reasonable as a temporary measure to set a limit of 4 p.p.m. for roasted or dried chicory. It is considered that the contamination which occurs during the drying process could be substantially reduced by modifying the method of drying and it is proposed that this limit should be reviewed periodically.

Content of arsenic in apple pectin is also affected by the use of lead arsenate sprays. For the time being a limit of 2 p.p.m. is recommended for solid or liquid pectin.

In regard to phosphatic constituents of raising powders it has been pointed out that the present description is not sufficiently specific and would not include a substance such as tri-calcium phosphate which is not used as a raising ingredient. This could be overcome by amending the description to 'phosphates of ammonia, calcium and sodium'.

Calculated by Weight

It was agreed that in any Order issued it should be made clear that arsenic content should be calculated by weight; and accordingly the limits should be expressed as 'parts per million by weight'.

Members of the sub-committee were: Mr. G. G. Barnes (chairman), Professor G. R. Cameron, Dr. L. E. Campbell, Professor S. J. Cowell, Dr. J. R. Johnston, Dr. W. P. Kennedy, Dr. G. W. Monier-Williams, Dr. J. R. Nicholls, Dr. G. Roche Lynch, Mr. G. Taylor and Mr. B. W. Smith (secretary).

Any further representations on these recommendations should be addressed to the Secretary of the Metallic Contamination Sub-Committee of the Food Standards Committee at the offices of the Ministry of Food, Food Standards and Labelling Division, 47 Portman Square, London, W.1. The closing date for the receipt of representations is 15 October, 1951.

A Man of Vision

Centenary of Birth of First Lord Leverhulme

The centenary of the birth of William Hesketh Lever, first Lord Leverhulme, occurred on Wednesday, 19 September. Its commemoration has been centred mainly at Port Sunlight with special excursions for long service workers and other events including a centenary concert on the anniversary day. In London a delightful exhibition, which contrives to catch and convey a great deal of the personality of the man, is being held at Unilever House, headquarters of the vast organisation built up by him. A soap maker and edible oil processer, Lord Leverhulme was well-known to the industrial chemists of his day and was recognised by them in 1924—the year before his death

QUAINT old soap cutting machine used by William Hesketh Lever at the age of 15, when an apprentice in his father's shop in Bolton, Lancashire, is among the many items at present on view in London, which help vividly to recall the life and character of one of the most outstanding figures in British commerce.

It was not until 1884, when he was 33 and had already acquired a modest fortune by his remarkable expansion of the family wholesale grocery business, that W. H. Lever entered the soap manufacturing business. Producing the first household soap to be sold in tablet form, within three years it had the largest sale of any in the world.

As a lad, young William had dreamt of being an architect, and his skill with a pencil can be appreciated in a sketch of a Swiss village scene drawn when he was between 12 and 14 years of age. The architect in him came to the surface in 1888 when he drew up his plans for a model industrial village at Port Sunlight, the first sod of which was cut by Mrs. Lever on 3 March that year.

Overseas Ventures

Before the factory at Port Sunlight was completed the first selling agencies overseas were established. By 1900, the Lever brothers had factories in Australia, Canada, the U.S.A., Belgium, Germany, and Switzerland. William chose the sites himself and scrutinised all the plans in detail. He was original and enthusiastic in his attempts to capture fresh markets both at home and overseas. In 1898 a washing competition, the 'Fêtes des Blanchisseuses', was organised as a publicity measure to gain a foothold in the soap trade in Switzerland.

It was not always smooth going, however, and progress in America was at first disappointing. In 1895 William wrote to his father: 'I should hate to face failure here, and we have run the risk—however, I hope it will be a big success, as big as in England'

'Progress'

A great traveller, a collection of his descriptive articles on his first voyage round the world were collected in a book under the title of 'Follow the Flag'. The present-day prolific output of 'house' magazines may well be traced back to the initiative of W. H. Lever for in October, 1899, appeared the first issue of 'Progress', published as a means of intercommunication between the firm's branches at home and abroad.

A man of many accomplishments and varied tastes, William Lever was well ahead of his time in his ideas. He was a strong advocate of co-partnership and Port Sunlight village was one of his ways of sharing the prosperity of the business with his employees. A Non-Conformist and a Liberal in politics he introduced retirement pensions in 1904 and later provided benefits for those who became sick or unemployed. A firm believer in education, he established a staff training college to provide in working hours general education for employees under 18 years of age.

As a public figure he became M.P. for Wirral in 1906. He was closely connected with the introduction of the first Old Age Pensions Bill and first proposed the payment

of M.P.s. A great public benefactor he gave to the nation as the home of the London Museum, Lancaster House, which unfortunately since the war still remains in possession of the Government.

He fought and won a famous libel action in 1907 and was awarded £91,000—the highest damages in legal history up to that time. But he did not retain his winnings personally. Instead he made the total up to a round figure of £100,000 and gave it to Liverpool University to found schools of Civic Design, Tropical Medicine and Russian Studies.

A lover of the arts, he started modestly when he set up house on getting married, by buying a shepherd and shepherdess in Derby biscuit-ware. From those two pieces grew the collections of furniture, porcelain and paintings, still to be seen in the Lady Lever Art Gallery erected to the memory of his wife, the foundation stone of which was laid by King George V.

In 1924, Viscount Leverhulme (for on being raised to the peerage he had joined his wife's maiden name to his own), was presented with the Messel Memorial Medal at the annual meeting of the Society of Chemical Industry. This award is presented biennially to eminent men distinguished either in chemical science or chemical industry.

From diaries and other records, from the scrupulous accounts he kept of his personal expenditures and adventures, and from his many witty and apposite sayings it is fortunately possible to build up a living picture of one of Britain's leading merchant adventurers.

Smoke Abatement

NATIONAL fuel problems and shortages, from the standpoint of the coal that is wasted in the form of smoke, will be the background of the three-day annual conference of the National Smoke Abatement Society that opens in Blackpool on 26 September. Over 400 members and delegates from local authorities, technical bodies, Government departments, and the fuel and power industries are already listed as attending.

One of the outstanding events will be the reading of the second Des Voeux Memorial Lecture '. ' Power and Waste in their Social Setting ' will be the theme of this year's lecturer, Dr. J. Bronowski, who is Director of the Central Research Establishment of the National Coal Board but is better known as author and broadcaster.

Also of importance will be a session in which representatives of the national coal, gas, electricity, iron and steel, and cement organisations will outline the policies being adopted for progressively preventing air pollution from these major industries.

Sir William and Lady Lever receiving staff at Thornton Manor, 1912

Benzene Shortage

Consumers Look to Petroleum

THE upsurge experienced by the organic chemical industry during the last year has been severely handicapped by the acute prevailing shortage of benzene. The situation has become so serious that the coke-oven industry—traditional prime source of benzole—is no longer able to cope with the demand.

In the United States, where the shortage is most acute, requirements have risen from 162,000,000 gallons in 1948 to an estimated 232,000,000 gallons during the current year. Furthermore, the spectacular increase in the demand for the principal users of benzene—styrene, phenol, and nylon—has led to a forecast benzene market of 411,000,000 gallons in 1955.

Benzene production from by-product coke-oven operations is intimately connected with the output of the steel industry. While there is some expansion planned in this field, its extent is by no means enough to provide the gap between expected benzene requirements and present production rates. Yield can be increased to a certain extent by more efficient and more extensive light oil recovery operations. But not even the most optimistic estimate will permit continued reliance on traditional sources for this essential chemical intermediate.

Alternative Sources

Alternative benzene sources include above all coal hydrogenation and petroleum processing. The first of these methods will yield a highly aromatic product from a widely available raw material. In petroleum-poor nations, coal hydrogenation offers a definite and favourable potential for the recovery of benzene (and tar acids) as a by-product of a nationally self-sustaining liquid fuels industry. In petroleum-rich economies, the use of high-pressure hydrogenation must, on the other hand, remain in abeyance. First cost of such plants is tremendous (£100,000,000 to produce 30,000,000 gallons per year of benzene as one of the products).

During the last few years, the petroleum industry has developed a number of processes which permit the production and recovery of benzene from natural oils at substantially lower investment costs. At this time, 12,000,000 gallons are already being produced by such means, and plans have been announced for a 60,000,000 gallons per year increase in petroleum-derived benzene capacity.

At least three basic types of process appear to be commercially attractive for the production of benzene from petroleum sources. In each case, the important raw material is the naphthenic C_6 fraction of the feedstock. Cyclohexane will yield benzene by simple dehydrogenation, while the more prevalent methyl cyclopentane must first be isomerised to cyclohexane before dehydrogenation may take place.

First U.S. Plant

The first synthetic benzene plant taken on stream in the United States relied on a version of the well-established hydroforming process. In this operation, the feedstock is reformed over a molybdenum-alumina catalyst in the presence of hydrogen at pressures ranging from 350-1,000 p.s.i. and at a temperature of between 930° and 985° F. The process requires periodic regeneration of the catalyst (about once every ten days) to remove carbonaceous deposits which reduce catalyst activity.

An alternate two-step method has been employed successfully by Shell Oil Company. In the first step, methyl cyclopentane is isomerised to cyclohexane, while the dehydrogenation to benzene occurs in the separate second stage. Little direct information has been released about the process actually employed, but it may be expected that a two-step operation will result in slightly higher yields and less off-stream time than is necessary in hydroforming processes.

Three fundamentally similar processes working towards the end of aromatics production have recently made their commercial début and promise to play an important part in the production of benzene, as well as in the manufacture of high-octane petrol. Two of these (developed by Atlantic Refining Company and Universal Oil Products, respectively) involve the use of a platinum catalyst. The third reforming process (licensed by Houdry Process Corporation under the name 'Houdriforming') operates

with a catalyst of undisclosed composition. Its aims, operating methods, and accomplishments are, however, similar to the other two.

In all of these processes, the production of aromatics is confined to the conversion of naphthenic compounds present in the feedstock. Paraffinic hydrocarbons which have not been removed will tend to be isomerised to a more highly knock-resistant branched-chain form. By sale of this upgraded by-product, the economics of benzene production may be significantly influenced.

Reactions Simultaneous

The isomerisation and dehydrogenation reactions involved are similar to those already discussed above. In the non-regenerative processes, the entire set of reactions is carried out simultaneously, although for thermal reasons a series of like converters with intermediate heaters is required (note that the dehydrogenation reactions are highly endothermic). The entire heat of reaction is supplied by the sensible heat of the feedstock. The processes also lend themselves, however, to the use of indirect heat exchange methods, such as those practiced in catalytic cracking. Announcement has recently been made that the M. W. Kellogg Company will erect the world's first fluid catalyst hydroforming unit.

Production of benzene from petroleum sources brings with it new problems of purification. At least two new processes have become available to recover benzene present in crude or thermally cracked oils. In these stocks, the quantity of aromatics is relatively small, and the thermal efficiency of straight distillation would turn out to be excessively low. These methods may also be applied to advantage to the reformates formed in the processes described above, which constitute a much richer source of benzene.

One of these processes is an extension of the solvent extraction methods which are now widely practiced for the removal of higher aromatics in lubricating oil refining. Among the solvents which can be used for the specific requirements of benzene recovery, diethylene glycol figures prominently. A recent study shows outstanding preferential solvent characteristics for aromatics exhibited by β,β'-oxydipropionitrile. The very high distribution coefficient may make this chemical a solvent of very great commercial usefulness in spite of its high cost.

Particularly significant is the adsorption type process developed by Sun Oil Company and designated as 'Arosorb' process. This method is about to reach commercial realisation as a clean-up unit for a Houdriforming plant to be erected at Sun's Marcus Hook refinery. This plant, which is designed to produce an annual 13,000,000 gallons of benzene, 30,000,000 gallons of toluene and 15,000,000 gallons of xylene, is expected to cost some £3,000,000.

The process involves the preferential adsorption of aromatic compounds on a specially prepared grade of silica gel. The separation at this stage is not clear-cut, and the sorbate also contains smaller amounts of naphthenics and paraffins from the feedstock. More thorough separation is subsequently accomplished by stage-wise desorption. The aromatic sorbate is first elutriated from the silica gel by means of an aromatic solvent (Sun Oil will use xylenes for this purpose). The remaining adsorbed saturates are then desorbed from the silica gel by the passage of a paraffinic solvent (the Marcus Hook refinery will use butane). Since these auxiliary solvents have a boiling point sufficiently apart from the process hydrocarbons (*i.e.*, the C_6 and C_7 fraction), they may be readily separated from them by distillation.

Solvent rate in the Arosorb process for a charge containing 35 per cent aromatics is reported to be 2 barrels of xylenes and 0.5 barrels of butanes per barrel of feedstock. Because of the nature of the charge at Marcus Hook, the process will actually yield rather than consume xylenes in the overall picture. Make-up butane must, of course, be supplied from an outside source.

Recovery of aromatics in the process is high. Yield is a function of the required purity of aromatics. For one set of conditions, a 98 per cent purity can be obtained in 90 per cent yield, while a 96 per cent recovery is possible if 94 per cent purity suffices. The process is believed to be the first large-scale application of selective adsorption using silica gel.

Bituminous Schist Used in Brazil

Swedish interests plan to install equipment in Brazil, at an estimated cost of 500,000,000 Cruzeiros, to produce liquid fuel from bituminous schist.

Hot Dip Galvanising

American and British Methods Compared

CHEMICALLY and metallurgically, American hot dip galvanising is not greatly different from British practice, the main distinction being the overriding preference in the U.S.A. for hot sulphuric acid pickling. This was one of the main conclusions of a specialist team representing the Hot Dip Galvanising Industry which visited the U.S.A. in the autumn of 1950 sponsored by the Anglo-American Council on Productivity with ECA technical assistance.

The report, published this week (3s. 3d. post paid), points out that at the time of the visit of the team American galvanisers were suffering from a temporary shortage of zinc, which affected the operation of many plants. Since its return, the supply of zinc to galvanisers in the U.K. has been even more severely curtailed. While, therefore adoption at the present time of some of its recommendations may not be possible, the need of conserving resources may have added to the importance of others.

Although the team went out as a specialist and not a productivity team, it soon became evident that the greatest lessons were to be learnt in the matter of work handling. In fact, the technical processes in many works were simpler and less efficient than modern British practice, but they were considered by the Americans to be of secondary importance compared with means to secure the maximum output.

No Dry Galvanising

Though most of the American firms used a pre-flux, none was found to be doing dry galvanising, that is, using a bath with no flux blanket at the entry end.

Generally the flux blanket was intended to be thick enough to dry and pre-heat the work before it met the molten zinc; consequently the work was often allowed to enter the flux blanket while it was still wet.

Construction of American galvanising equipment differed from British mainly in the extensive use of timber for pickling vats, though brick vats with acid-resisting linings were also seen and were claimed by some to be more economical because of their longer life. The types of galvanising baths were all familiar, and the kettles used were similar to those found in Britain.

Only one plant using gas or oil as fuel had a separate combustion chamber; instead, burners were arranged in various ways around the kettle. Only one firm kept a regular check on flue temperatures.

The electrically-heated baths aroused much admiration in those who saw them, but it is not likely that any British galvaniser will find them economical so long as his electric power is derived from coal. There is no doubt that ease of control and cleanliness make electric power ideal for heating galvanising baths.

No Current Research

There appeared to be no current research into the galvanising process which would be of assistance to the general galvaniser. Electric induction heated baths were being tried, but primarily with a view to using them for wire galvanising, though experiments were being made with hollow-ware and castings. The steel strip producers were investigating new continuous galvanising processes, and the use of the Sendzimir and similar processes was expanding.

Some research was being carried out into the behaviour of galvanised coatings under corrosive conditions, particularly those met in hot water systems, when the steel/zinc potential may be reversed. The American Hot Dip Galvanisers' Association did good work in stimulating members to help each other with their technical problems, and in keeping them informed of published advances in galvanising technique, but had no facilities of its own for doing research.

Many of the firms visited had their own zinc ash recovery plants, and the results undoubtedly justified the installation of the necessary equipment.

As in Britain most firms add small quantities of aluminium to the molten zinc. While some firms claim a reduction in pick-up, the majority are mainly concerned with improving the appearance of the coating, which was generally excellent.

In view of the present shortage of zinc and its high price—now 50 per cent more than when the team sailed for the U.S.A.—

attention to economy is of great importance. Details are given of a zinc economy incentive scheme used in a large hollow-ware galvanising plant which is said to give a resultant 15 per cent saving in zinc.

The team was favourably impressed by the extensive use made everywhere of mechanical handling devices throughout the galvanising process. Time and method study engineers were employed in many plants and given full scope to develop their ideas in order to obtain maximum productivity, and much ingenuity was displayed in designing racks, cradles, jigs, and so on.

Most of the shops seen were no larger than many in Britain, but the volume of work passing through them was much greater. Otherwise expressed, the Americans make more extensive use of their capital equipment. The number of men per galvanising bath is greater than in Britain, and the quantity of work galvanised per man-hour, which is a measure of productivity, exceeds that in British works.

This faster rate of working is due not to greater physical effort but partly to the way in which the labour force is deployed and partly to the care given to the design of handling equipment.

Of importance is the thought which is given by management to ensure an even flow of work and to the handling facilities needed by each particular type of article. Physical effort is lightened as far as possible by mechanical aids and by reducing each job to the simplest degree attainable. This appears to result in a greater intensity or continuity of effort.

Recommendations made by the team include the following points:—

Shop Construction and Equipment

Ventilation

Where possible, increased use should be made of hoods, extraction ducts and fans to give as good an atmosphere as possible in the galvanising shop.

Hoists and Conveyors

The maximum use should be made of travelling hoists of relatively light capacity (5-10 cwt.) to eliminate heavy manual work.

Inspection and Maintenance

When possible, stand-by baths should be provided so that the working baths can be changed at regular intervals for inspection and repair. By regular inspection it is possible practically to eliminate kettle failures, so that run-out pits are not needed.

Degreasing

Where necessary, hot alkaline degreasing should precede cold hydrochloric acid pickling. It is valuable, but not essential, before hot sulphuric acid pickling.

Rinsing and Pre-fluxing

Proper rinsing with flowing water should follow pickling to remove iron salts which would otherwise contribute to the formation of dross in the galvanising bath. A dip in a neutral pre-flux is advisable after rinsing to prevent the formation of excessive amounts of iron compounds on the surface of the articles to be galvanised and to promote good coating.

The widespread use of thick flux blankets at the entry end of the bath was an interesting feature of American galvanising practice. The use of such blankets in most cases was said to render the use of a drying oven unnecessary. The relative effect of the flux blanket in reducing zinc losses by oxidation as compared with the formation of flux skimmings containing zinc is a matter for further investigation, and should be referred to the technical and research associations connected with the galvanising industry.

Dipping Technique

Immersion time and withdrawal rate

The weight and uniformity of the galvanised coating is much influenced by the time of immersion and the rate of withdrawal. The best times and speeds should be determined for each article and mechanical means should be used to ensure a steady withdrawal at the correct rate.

Residues

Ash

Recovery of a substantial proportion of the entrained metal in ash is simple and economical. After separation of oxide from metal in a ball mill the metal residue should be melted down by immersion in a pool of molten zinc in a separate furnace. The melting pot should be of refractory material and the temperature should be closely controlled. A less efficient alternative is to add the zinc granules directly to the galvanising bath, preferably through a chute.

Dross

The recovery of zinc from dross by distillation requires some capital expenditure on plant; though not suitable for small firms it can be considered by large firms or groups of firms combining to erect suitable plant.

Delivery of Zinc

The delivery of zinc in pallets of about

15 cwt., consisting of a number of slabs capable of being handled by a forklift truck, saves much time in loading and unloading and transport. The zinc suppliers should be asked to consider supplying zinc in this form to those who desire it.

Zinc Economy

The introduction of a zinc economy bonus scheme for teams of picklers and galvanisers should be given consideration by every galvanising firm.

Costing

More consideration should be given to the time factor in costing job galvanising.

Supervision

Consideration should be given to the employment of men with higher technical qualifications as supervisors of galvanising departments, and opportunities should be made available for foremen and others to acquire knowledge of production engineering and time and method study. The Hot Dip Galvanisers' Association should consider arranging special classes of elementary instruction in these subjects.

Labour

Interchangeability of labour in the galvanising shops should be made possible by courses of instruction within firms.

Safety

The wearing of properly designed eye or face shields should be encouraged.

Reports on individual plants are given in one of the appendices. In firm 'A' it is stated in connection with degreasing that the chemist considers a hot soap-type cleaner is essential to maintain high quality and avoid rejects, and uses a solution of caustic soda, tri-sodium phosphate and sodium metasilicate containing about 0.3 per cent wetting agent. The temperature is 180°-200°F., and the strength 2 oz./gal. (U.S.); the immersion time is 20 min. Sodium metasilicate degreasing is also used before welding to avoid carbon deposits. Cleaner is held in a steel tank.

At the same firm there is a modern well-equipped chemical and metallurgical control laboratory which also provides facilities for development work. It is normally staffed by a chemist and one assistant, who has recently been called up. The equipment includes a Bausch and Lomb metallurgical microscope.

The following information of general interest was given: Various organic coatings (including 'Teflon') for water heater cylinders have been tried, but all tend to blister in contact with hot water. Other firms have tried a phenolic resin coating in conjunction with a magnesium anode, with reportedly moderate success.

The chemist considers magnesium anodes to have a more restricted usefulness than is sometimes claimed. They are really only effective in water with 80-200 p.p.m. total solids. In very soft water where the total solid is only 10 p.p.m., iron rust is deposited on the magnesium. The following analyses were given for commercially available anodes:

Extrusion alloy: Al, 3 per cent; Zn, 1.5 per cent.; Mn, 0.3 per cent; Mg. the rest.

Casting alloy for high conductivity waters: Al, 18-20 per cent; Zn, 3 per cent; Mn, 0.4 per cent; Mg, the rest.

Casting alloy for low conductivity waters: Al 5.3-6.7 per cent; Zn, 13.5-16.0 per cent; Mn, 0.15 per cent; Mg, the rest.

All galvanised steel water heaters are fitted with copper draw-off tubes, and are often installed in systems with copper pipes, but such mixed systems do not seem to have caused corrosion troubles in the U.S. The chemist thinks that this may be because galvanised steel is not considered suitable for use with cuprosolvent waters, in which such trouble might arise.

Instrument Technology

DETAILS of the first meetings of the 1951/52 session of the Society of Instrument Technology have now been announced. The opening address will be given on 30 October by the president, Mr. E. B. Moss, whose subject will be 'Development of Materials for Instrument Manufacture.'

'Visual Presentation of Instrument Data' will be the next paper, and will be delivered by K. F. H. Murrell, of the Royal Naval Scientific Service on 27 November.

The third meeting on 29 January 1952, will be devoted to the Control Section, and Professor A. Tustin of Birmingham University, will speak on 'Some Mechanical Considerations in the Design of Servo Systems.'

All the above meetings are on Tuesdays and will be held at 6.30 for 7.0 p.m. in the lecture theatre of the Royal Society of Tropical Medicine and Hygiene, Manson House, Portland Place, London, W.1.

• OVERSEAS •

Low Cost Titanium

A low cost method of refining titanium is reported in an American patent filed by the Dominium Magnesium Company, Ltd. The patent describes a sintering process in which bars, compacts or briquettes are sintered at 1,000°C. in the absence of air and in the presence of an alkaline earth metal more reactive to oxygen, nitrogen and hydrogen than titanium. Calcium is preferred for this task, although lithium, magnesium, strontium and barium may also be used. The American government is urging expansion of titanium output.

More Cold Rubber

An increase in the output of cold rubber to 75 per cent of its entire general purpose synthetic rubber programme is announced by the U.S. Government. Out of the present monthly production of 63,808 tons of GR-S, slightly more than 50 per cent is cold rubber. The Reconstruction Finance Corporation has been told by National Production Administrator, Mr. M. Fleischmann, to increase cold rubber production to a monthly rate of 53,770 tons or 75 per cent of the 71,720-ton capacity to be reached under the Government's output expansion scheme.

Indian Ferromanganese Plant

A new ferromanganese plant costing £750,000 is to be set up in India by the American Brainard International Company by agreement with the Indian government. Its annual capacity will be 25,000 tons of ferro-manganese and it will be located in Orissa. The ownership will be 49 per cent Indian and 51 per cent American.

Technical Aid for Colombian Oil

According to a statement issued by the Esso Colombiana S.A., a contract has been signed between the International Petroleum Company and the Empresa Colombiana de Petroleos for technical assistance in the production of crude oil at El Centro, for the management and extension of the refining plants and for construction of an oil pipeline from Cantimplora to Puerto Salgar. This pipe-line will connect with one now in course of construction for the Cundinamarco Department from Puerto Salgar to Bogota.

Quicksilver Mine Reopened

The New Idria quicksilver mine, for a long time rated as the largest producer in the United States, has resumed operations after being shut down for three years according to a report from Hollister, Calif. The New Idria Mining and Chemical Company, San Francisco, Calif., has reopened the property with an initial force of 40 workers.

Canadian Sulphur Project

Construction of a £2,500,000 expansion to double the capacity of its sulphuric acid facilities has been begun at its plant at Valley Field, Quebec, by the Nichols Chemical Company. The new plant is designed to take advantage of Canada's resources of pyrites and other sulphur-bearing ores. Operations are expected to begin next spring.

Swedish Iron Ore

Shipments of iron ore from the North Swedish port of Lulea are expected to reach 3,500,000 tons this season. Iron ore trains from the interior to the port are running at the rate of nine or ten per day, and shipments amount to between 30,000 and 35,000 tons per day. Efforts are being made to speed up loadings into the vessels, as shipments are behind schedule due to shipping firms holding back tonnage during May and June in the hope of higher freight charges.

Spain Steps Up Bauxite Production

The almost complete dependence on foreign supplies for aluminium has led the Government to review home production of bauxite, which is exploited in three distinct zones in the north, south and centre of Catalonia, where there is an estimated total of some 4,000,000 tons. While it is realised that the Catalan mineral is at present of inferior quality with too great a percentage of silica, it is felt that the formation of a State enterprise backed by the necessary financial resources from the Government may give substantially better results. It is understood that the Empresa Nacional de Aluminio of Valladolid and La Alquimia, another national concern, will participate in this new scheme.

Publications & Announcements

THE Dry Ice Journal, or the 'International Trade Journal for all Carbon Dioxide Questions', has recently made its first appearance, after interruption, from Germany. Scheduled to appear monthly, the journal has three sections, one in English, one in French, and one in German, all different in content. The present issue contains items in the English section on the London Refrigeration Congress, the CO_2 industry in England, and various other news items. Subscription is $6 per year for twelves issues, or approximately £2 2s.

* * *

THE Coal Tar Research Association has recently issued a review of coal tar technology from July-December, 1950. Price 5s., it is divided into two sections—coal tar and its products, and general chemistry and chemical technique, with subjects covered by fourteen sub-sections. A comprehensive number of papers, reports, and patents is listed, and there is a subject index at the end.

* * *

A NEW publication entitled 'The Mechanical Properties of Nickel Alloy Steels' has been issued by The Mond Nickel Company, Limited. The steels are divided into two main groups, direct-hardening and case-hardening. Specification details (chemical composition, heat-treatment and mechanical properties) are given for each steel, together with representative test results which show the effect of mass. Tempering diagrams are included for the direct-hardening steels.

To meet the present need to conserve alloying elements, there are some 'economy' steels. Many of the standard steels described will again be available when the present situation has passed, so that the publication will provide useful information to those now dealing with designs in the early stage.

Among more general data are tables showing the effect of tempering and sub-zero treatment on case-hardness, torsion test results, a graph showing the effect of surface condition on fatigue strength and a comparison of the various official tensile and impact test pieces in use.

Copies of the booklet are obtainable, free of charge, from the company.

A NEW strippable coating for the protection of spray booths has just been announced by The Pyrene Company Ltd. The advantages of 'Pultac,' as the new material is called, are said to be that it is non-inflammable, is resistant to thinners, requires no special equipment or skill to apply, and is very easily stripped after use. It is a water-base material, needs no solvent, and, being expendable, involves no recovery. All that is required before application is a thorough cleaning down of the spray booth walls to their original surface, when the 'Pultac' is applied with an ordinary paint-type spray gun, preferably with a large nozzle, at an optimum air pressure of 60-80 p.s.i. Optimum coverage is at the rate of 200-300 sq. ft. per gallon, and the material requires two hours drying time before the booth can be used. 'Pultac' may be applied to all surfaces, such as steel, aluminium, galvanised, vitreous, glass and tiles, and effects considerable saving in the cost of booth maintenance, say the company, by making the removal of over-spray paint a simple and rapid task. The covering may be removed simply by tearing it off.

* * *

'LAUNDRIES & Laundry Requisites, 1951' is now available from the Anglo-Scottish Press, Ltd., price 7s. 6d. The increase of 2s. 6d. on last year's price is due to increases in material costs. This useful guide to products and manufacturers in any way connected with laundries and laundering contains three parts—Part I being an index of laundry requisites, Part II being a Directory of laundries, and Part III a list of dyers and cleaners. It is the same size as last year.

* * *

THE BSI have published their monthly information sheet for August, 1951. In it are details of new and revised British Standards and their amendments. Future publications and new work started are also shown, and a list of new overseas standards that have been added to the BSI library is included, as well as draft standards received from overseas countries, and new work started abroad. 'Fifty Years of British Standards, 1901-51', an interesting history of the standards movement, about which too many people know far too little—is also described.

THE August number of the journal of the Royal Institute of Chemistry shows some changes in its usual form. Having been in the process of a gradual change in both format and content over the last five years, the journal now replaces its previously omitted reports on Proceedings in Council and the conferences of hon. secretaries of local sections, with a section entitled 'Institute Affairs', in which are mentioned forthcoming examinations, lectures, current developments, etc. The journal also contains a report on 'Science in Parliament', book reviews, examination results, and a lecture summary.

* * *

TREATMENT of rust-bound scraper chain and other corroded metals parts is described in a new leaflet by the Plus-Gas Generator Co., Ltd. Marketing two products, one called Formula 'A' Plus-Gas Anti-Corrosion Fluid, the other Formula 'B', the company says that the first will remove rust completely and loosen corroded parts in a few minutes, and that immersion in the second will protect machinery and metal parts from corrosion, and ensure easy dismantling in the future. Formula 'A' also removes carbon deposits.

* * *

ISSUED by the Mond Nickel Company, the Nickel Bulletin for July, 1951, gives a good account of up-to-date information on nickel and its alloys. Growing interest in the new spheroidal graphite cast irons is shown by three abstracts, one on their development in France, another on their use for gears as investigated in America, and one on their magnetic properties. Other abstracts of interest deal with the creep of metals, the sub-zero properties of nickel alloy steels, and the use of nickel-chromium corrosion-resistant steels in the petroleum industry. Copies of the Bulletin may be obtained free of charge from the Mond Nickel Company.

* * *

HYDROGENATION to raise the melting point of a liquid oil so as to render it suitable for the manufacture of an edible or technical fat, is the subject of its latest booklet 'P-G Vegetable and Animal Oil Processing Plant—Hydrogenation', just issued by the Power-Gas Corporation, Ltd. Nickel is shown to have proved the best catalyst, and a description is given of the basic chemical aspects, production of hydrogen, and the hardening process.

ONE of the endless tasks in the promotion of a relatively new metal such as aluminium is that of educating people about its properties and techniques for handling and applications. A successful experiment in stimulating interest was recently carried out in Greece by L'Aluminium S.A. of Switzerland. Two courses on welding and brazing of aluminium given in Athens are described in *Aluminium News* (No. 8), published by the Aluminium Union, Ltd., Montreal, Canada. The outstanding use of aluminium in the continuous rolling mill at Rogerstone, South Wales, is also described and illustrated.

* * *

THE French possess a very reliable reference to French chemical industry in their 'Guide de la Chimie', published by the Union des Industries Chimiques, 64 Avenue Marceau, Paris (8e). The 1951-2 issue which has just come out is divided into nine sections, and gives the names and addresses of all important administrative and professional organisations dealing with the chemical industry; an alphabetical list of products with their descriptions, properties and synonyms—as well as their English and German names; a buyer's guide of products and their manufacturers, an alphabetical and geographical list of firms; a catalogue of laboratories—analytical, industrial and pharmaceutical; a list of importers and exporters, and another of suppliers of apparatus and instruments for chemical industry and research. The guide is very comprehensive. There is always the difficulty in books of this kind of deciding how many industries come under the classification of 'chemical', but the 'Guide de la Chimie' includes a wide range of related industries without in any way attaining unwieldy proportions.

* * *

THE first report on the progress of the Mechanical Engineering Research Board—appointed in 1946—is now available from HMSO (2s. 6d.). It gives details of the origin of the research station, the scope of its work, and the progress which has been achieved so far. Much of the work up to now has been done at the National Physical Laboratory. Work carried out covers the unification of screw threads, the effect of size on fatigue strength, properties of metals at high temperatures, fretting corrosion and surface finish measurement by the method of taking 'plastic replicas'.

HOME

Paint and Rubber Technology

Classes in paint and rubber technology are being resumed in Glasgow with the support of the paint and colour section of the Chamber of Commerce, the Institute of Rubber Industry and the rubber trade in the area. Courses will deal with the raw materials, plant and processes involved.

British Pharmaceuticals

The Association of British Chemical Manufacturers announces that any firm in the pharmaceutical industry which has not already received a complimentary copy of the productivity team's report (THE CHEMICAL AGE 65, 317) is entitled to one free copy which may be obtained from its Intelligence Officer, 166 Piccadilly, London, W.1. Copies of the report may also be purchased from the ABCM on the following cash-with-order terms: 1-19 copies 3s. each post paid; 20 copies and over 2s. 3d. post paid.

Scottish Scientific Instruments

Considerable progress in the last two years has been made by a Glasgow firm, which specialises in the design, production and repair of scientific instruments. Particular attention has been paid to instrumentation for the paper industry, and a number of new designs of testing equipment have been made to replace German apparatus. An electronic fraction collector is now being made for Glasgow University. Partners in the company are Mr. C. H. Drewell and Mr. S. C. Duncan.

Exploration Syndicate

It was stated on page 333 of THE CHEMICAL AGE of 8 September, 1951, that Monsanto Chemicals was one of eleven companies which formed the United Sulphuric Acid Corporation this year. In point of fact, Monsanto Chemicals is not associated with this organisation.

Head Office Moves

The head office of the Witco Chemical Co., Ltd., will be moved on 1 October from Baker Street to more commodious and central premises at Bush House, Aldwych, London, W.C.2. The telephone numbers will be TEMple Bar 6473/6476.

ACTH Manufacture

At a meeting of doctors and specialists at Harrogate last week it was stated that laboratories for the production of ACTH would be set up at Eastbourne next year.

PERSONAL

MR. S. W. CHEVELEY, managing director of Plant Protection, Ltd., since 1944, has been appointed chairman of the Central Agricultural Control of Imperial Chemical Industries Ltd., with effect from 1 January, 1952, in succession to MR. F. C. O. SPEYER, C.B.E., who is retiring at the end of this year. Mr. Cheveley, who gained part of his farming experience in Cumberland, was associated with Sir Frederick Keeble in the formation of Jealott's Hill Research Station, Berkshire, and took a prominent part in the development of grass drying under Dr. R. E. Slade.

PROFESSOR T. P. HILDITCH, for 25 years Professor of Industrial Chemistry at Liverpool University, who is retiring this year, received gifts from past and present students at a dinner in Liverpool on 15 September.

MR. HENRY T. F. RHODES, chairman of the London Section Committee of the British Association of Chemists, has resigned his position as Manager (Chemicals) of the B.S.E. Company, Limited, to become manager of Watts Chemicals, Limited, 34 Ludgate Hill, E.C.4.

MR. H. NEWTON, the retiring treasurer of the Scottish section of the Oil and Colour Chemists' Association, has been presented with a gold pencil in appreciation of his services while in office.

Messrs. Kaylene, Ltd., announce that MR. H. C. GULL, M.Sc., has joined their staff as technical and production manager. Mr. Gull was formerly engaged on explosives production with the Ministry of Supply, and has extensive post-war experience of production in the German chemical industry.

MR. H. C. REEVES, B.Sc., (Eng.), A.M.Inst.C.E., D.I.C., has been appointed chief fan designer of Air Control Installations, Ltd.

Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

BARCLAY & SONS, LTD., London, E.C., chemists, etc. (M., 22/9/51). 30 July, charge, to Barclays Bank, Ltd., securing all moneys due or to become due to the bank; charged on 37, 38 and 39 Devonshire Place, Brighton. *Floating charge up to £25,000. 11 July, 1950.

MEDO-CHEMICALS, LTD., London, N. (M., 22/9/51). 25 July, mortgage, to Westminster bank, Ltd., securing all moneys due or to become due to the bank; charged on 178 and 180 Pentonville Road, N. *—. 24 December.

SOZOL (1924), LTD. (now SURFACE PROTECTION, LTD.), London, E.C., manufacturers of chemical preparations. (M., 22/9/51). 23 July, debentures, to Barclays Bank, Ltd., securing all moneys due or to become due to the bank: general charge. *£550. 12 January, 1951.

G. E. WAKEFIELD (CHEMIST), LTD., Hucknall. (M., 22/9/51). 25 July, mortgage, to Midland Bank, Ltd., securing all moneys due or to become due to the bank; charged on 7 Guildhall Street, Lincoln, with fixtures.

New Registrations

Whysall and Sons, Ltd.

Private company. (499,270). Capital £3,000. Retail and wholesale chemists, druggists, pharmacists, drysalters, oil and colour men, etc. Directors: G. E. Whysall, K. T. Whysall, and R. E. C. Whysall. Solicitors: Henry Thompson & Sons, Grantham.

Receivership

The following receivership has been renounced: H. E. Traylen, of Thames House, Queen Street Place, E.C.4, ceased to act as Receiver on 2 August, 1951, of TURKDEAN, LTD.

Increases of Capital

The following increases of capital have been announced: BERNARD KEEGAN LTD., from £6,000 to £50,000; SANDOZ PRODUCTS LTD., from £100,000 to £360,000; LYDEBROOK CHEMICAL CO., LTD., from £200 to £1,000.

Company News

Powell Duffryn, Ltd.

The directors of Powell Duffryn, Ltd., have announced that the annual general meeting will be held on 10 October, 1951.

The consolidated net profit for the year ended 31 March, 1951, is £604,934 (previous year £647,073) after crediting transfer from taxation reserves £72,452 (£66,248) and after charging depreciation £310,516 (£232,661) and taxation £1,041,460 (£934,676).

The directors recommend payment of a final dividend of 5 per cent actual, less income tax at 9s. 6d. in the £ on the £9,660,471 ordinary stock in respect of the year ended 31 March, 1951 (making with the interim dividend of 3 per cent actual, paid on 23 February, 1951, 8 per cent for the year).

The amount at the credit of the consolidated profit and loss appropriation account to be carried forward to 1951/52 is £2,295,234 (£2,222,714).

Payment of the above-mentioned dividend will be made on 24 October, 1951, to holders registered on the books of the company at the close of business on 10 September, 1951.

London Market Report

LONDON, Wednesday, 19 September.—A steady buying movement for home account continues throughout the industrial chemical sections of the market and fresh inquiries for export have been on a good scale. Chlorate of soda, hyposulphite of soda and bichromate of soda have been active items and the demand for the potash compounds continues at a fair level. In other directions there has been a brisk call for arsenic, formaldehyde and peroxide of hydrogen. In the coal tar products market business remains steady, and with the exception of cresylic acid the overall supply position has shown some improvement. Prices are steady and unchanged.

The Distillers Co., Ltd.

Problems of Raw Material Shortages & Prices

THE 74th annual general meeting of The Distillers Co., Ltd., was held in the North British Station Hotel, Edinburgh, on Friday, 14 September 1951, when the chairman, Mr. H. J. Ross, presided.

The chairman said: The only changes which I have to report among the directorate since we met a year ago are the retirement from executive duty of Mr. David S. Forsyth, which coincides with this annual meeting, and the elevation of Mr. T. F. A. Board and Mr. R. S. Cumming to the management committee.

From the statement of accounts it will be seen that the manufacturing and trading profits of the company and its subsidiaries amounted to £17,934,520 as against £12,837,691 for the previous year. To the profit is added income from investments and a small gain on exchange, making the total revenue £18,411,095. Taxation takes the very substantial figure of £9,519,035, and after making the usual provisions for depreciation, writings off, interest on debentures and loans and allowance for interests of outside shareholders, the net profit attributable to the group is £6,858,925 (£5,930,557).

The revenue reserves in the books of subsidiary companies have been strengthened by transfer thereto of £3,265,847 and the directors have agreed to appropriate £750,000 to the general revenue reserve of the parent company. As mentioned in the report by the directors the surplus on the superannuation and provident reserves of the participating companies amounting to £388,644 has been credited to profit and loss account. The balance available is £3,231,722 and after provision for the dividends distributed or recommended. the carry forwards are increased by £458,812 to £6,445,165.

Record Profit

Profit at nearly 18 million sterling is a record in the long history of the company. It is satisfactory that all sections of the company have contributed to this substantial increase of a little over £5 million. The Scotch whisky blending companies continued to have—and, in fact, still have—the benefit of the adjusted prices for the U.S.A., Canada and other parts of the world following the devaluation of sterling. This brought additional revenue to the companies, although there was an offset to this in the increased costs of production and selling.

Increased outputs obtained from the extensions and improvements brought about by the expansion programme have played a very important part in obtaining these good results. The yields now being obtained from the money put into the new capital development schemes are proving very satisfactory and mainly in excess of the estimates. In saying this it must be remembered that under the conditions ruling at present in all sections of our organisation there is little difficulty in selling outputs; in fact the output itself is only limited by the essential raw materials available, and in those plants where there is no difficulty in this respect, by the capacity of the plant. This undoubtedly reflects a phenomenal pressure of demand which is worldwide, and which must be regarded as abnormal.

Price Problems

Raw material prices have risen considerably—to what is an artificial level due mainly to inflation—and this is a factor that has caused anxiety to your board. This rise has had its influence to some extent on the increased valuations of stocks shown in the consolidated accounts. The general level of prices may turn downwards without much warning, with substantial losses to be faced in the future. As a consequence the board decided to create a stock contingencies reserve and appropriate thereto out of profits the sum of £440,500. It appears certain—at least at this stage—that a similar course will have to be adopted at the end of the current year. Prudence, if not safety, will demand it.

The legal balance sheet of the company calls for the following comments:—

(1) The Ordinary Capital has been increased by 51,000 Shares of £1 each credited as fully paid issued to The United Molasses Co., Ltd., in exchange for £50,000 Ordinary Stock of Anchor Line, Ltd. The premium of £204,000 has been credited to Share Premium account. The Board is satisfied that

this transaction will unite even closer the two companies, and in the future will bring advantages to both;

(2) The amount at credit of the Investment Reserve has been used (a) to write down certain investments by £400,000, and (b) to add to the General Revenue Reserve £1,000,000. The Board feels that this Reserve is no longer required;

(3) Unsecured Loan Stocks stand at £10,000,000. This money was borrowed on reasonable terms. The cash provided has increased greatly the liquidity of the company;

(4) The Superannuation and Provident Reserve has now been taken from the Balance Sheet following the formation of the Trusts; and

(5) There are large increases in the amounts for Trade Investments and advances to Subsidiary Companies. These reflect payments in connection with the expansion programme, to which reference has been made in past years.

Increased Assets

In the consolidated balance sheet the effect of these developments is again shown by the increase in the book value of the fixed assets of the group by some £4 million. Among current assets it will be observed that the value of stocks has increased by approximately £7 million and that debts due to the group have risen by about £5.5 million.

Net liquid assets of the group increased during the year from approximately £50 million to £61 million but, as mentioned, the company augmented its liquid resources by borrowing £10 million.

Group capital reserves have increased by £650,000, due mainly to the premium on issue of the new shares already referred to, and to gains on realisation of investments. In addition, the proportion of profits retained in the business is such that despite the elimination of the group superannuation reserve, the total capital and reserves is practically unchanged at £53.5 million.

I have already referred to the fact that taxation has this year absorbed £9.5 million out of the company's profit. The full effect of the latest increase in profits tax is not revealed in the results for the year under review, and if profits remain constant, the Government's share may be still greater next year. It is imperative that some measure of relief from taxation should be given to industry, if it is not to be forced to restrict the volume of trade through lack of funds.

The company's malt and grain distilleries secured good outputs during the year under review and as a consequence the stocks of maturing whiskies of the blending companies in the group obtained satisfactory additions. The cask position has improved but still gives cause for some anxiety.

Our activities still remain substantially under Government direction and are largely patterned to the national interests. The result is that certain markets receive a special degree of attention denied to others and a situation is thus created which is not in the long term interests of either the company or the industry. This state of affairs will undoubtedly continue until such time as our stock position is capable of meeting all demands on an age and quality basis. It is not a matter of gallons alone; it is gallons plus age and quality—the basis on which this great industry has been built and on which alone it can be maintained. Unfortunately this fact is not easily impressed upon the official mind.

Last year I was able to report that a slightly larger gallonage had been permitted to the industry for home trade release, namely, 2.6 million proof gallons for the year ended 30 April, 1951. Actual releases for that period, however, were 46 per cent in excess of the target. The unsatisfactory feature of these excess clearances is the high price the trade and public are called upon to pay.

Rate of duty still remains at the excessive level of £10 10s. 10d. per proof gallon or, if expressed in perhaps more easily understood terms, slightly over 24s. 7d. per bottle. A continuance of this iniquitous rate of tax can only lead to the gradual extinction of Scotch whisky as a beverage on the home market, but it also serves to encourage overseas markets to increase their rates of duty on what is admitted to be, if not the most valuable, at least one of the most important commodities this country possesses.

Compliment to the Industry

Representations were made to the Chancellor of the Exchequer during the course of the year and the subject came under review in the debate on the Finance Bill in the House of Commons. Although the results were negative, I think that the compliment paid to the industry by the Financial

Secretary to the Treasury is worthy of repetition. He said:—

'The highest marks of all go to the whisky industry and if one measures it in terms of dollars its record is far more remarkable and better than that of any other industry. It is a remarkable feat by this great Scottish industry to have earned this high amount of dollars and yielded so much revenue to the exchequer at the same time'.

This governmental tribute may offer some slight ray of hope for the future because there is no doubt that our industry has played a most distinguished part in the efforts to assist and improve the post-war economy of the nation. In this your company has taken a very notable share.

Problems and difficulties of our export trade continue to increase rather than diminish. Import restrictions by various countries, exchange difficulties and other artificial restrictions on the free interchange of merchandise are a growing feature, symptomatic of the times and world conditions. It is to be hoped that with the passage of time, many of these hindrances to world-wide trade will disappear, but without these obstacles Scotch whisky, and in particular the various brands within our group, continues to grow in popularity.

Our trade with the priority markets, notably the U.S.A. and Canada was not only maintained but increased during the year under reviews. In South Africa, unfortunately, there has been no alteration of the position whereby supplies to this market are still subject to import licenses, the amounts of which are disappointingly small.

Gin Sales Records

Once again I am happy to report a most satisfactory year's trading by our gin companies, with substantial increases in both home and export markets. Our gin plant at Linden in the U.S.A. continues to provide very good results and our American gin sales for the year created yet another record.

Yeast factories were fully employed throughout the year with good yields and a product which earned the approval of our customers. The new factory under construction in Bristol should be ready for production at the scheduled time, early in the next calendar year.

In our industrial section, the year has been most active. This is primarily due to the large increase in our productive capacity resulting from the heavy capital programme of expansion on which we embarked after the war, the major part of which has been in commission during the year under review.

In the industrial alcohol department, output and efficiencies were well maintained, but the supply of molasses as I foreshadowed last year, has become very difficult owing to the abnormal demands of the U.S.A. market. Fortunately, through the efforts of our buying agents, The United Molasses Co., Ltd., we have been enabled substantially to meet the requirements of the trade, although the greatly increased cost of this raw material compelled us to increase our selling prices correspondingly. There is some indication that the supply position may ease during the current year, but I fear we cannot at present foresee the substantial reduction in price which we desire.

Carbon Dioxide Trade

Carbon dioxide trade has also remained at a high level and recently we purchased from Messrs. Turner & Newall, Ltd., their interests in this industry, comprising (a) shares in the Carbon Dioxide Co., Ltd., and (b) two production units located respectively at Manchester and Bootle.

Our industrial organic chemical companies, British Industrial Solvents, Ltd. and Commercial Solvents (Great Britain), Ltd., had a satisfactory year, most of the plant included in the expansion scheme at the Hull factory now being in production. Output was, however, hampered to some extent by raw material shortages and in one major chemical—acetone—we were compelled to ration supplies on account of the shortage of isopropyl alcohol. This position should now be rapidly rectified with the coming into operation of the Grangemouth plant.

In this connection, I am glad to tell you that since the end of the year under review, the plant of British Petroleum Chemicals, Ltd., at Grangemouth, has been commissioned.. You will remember that this company is jointly owned by The Anglo-Iranian Oil Co., Ltd., and your company. It is now producing synthetic ethyl alcohol and isopropyl alcohol, which will make a substantial and vital addition to the supply of these products.

Construction of the initial styrene plant of Forth Chemicals, Ltd., also at Grangemouth, is making satisfactory progress, and it is hoped to commission this during next

year. Active consideration is now being given to proposals for a substantial increase in the capacity of this plant in view of the growing demand for this important material.

The Biochemical Company, at Speke, Liverpool, has more than fulfilled our expectations and has fully justified our entry into this field. The favourable reception accorded to the 'Distaquaine' group of penicillin products, which I mentioned last year, was just a forerunner of the continually increasing world-wide demand for these specialities. Continued technical progress has not only resulted in increased production of these and other forms of penicillin, but has enabled us to make further considerable reductions in the selling prices. Streptomycin and Vitamin B_{12} have been added to our production range, and major extensions to our plant, now in hand, should provide greatly increased quantities of these two products by the end of 1952.

Plastics Progress

In my statement to the shareholders in 1949, I foreshadowed the benefits to be derived from the concentration at Barry, South Wales, of the plastic manufacturing units which were previously located in various areas. The increased demands for plastic materials, which started in 1950, have continued throughout the year, and British Resin Products, Ltd. is now obtaining the improved efficiencies and lower operating costs expected from the expanding use of the large new units installed.

Here, again, we have been seriously handicapped by the acute shortage of certain important raw materials, and considerable effort has been directed to the study of alternative materials in replacement of those in short supply. This work is bearing fruit, and will, we feel confident, lead to a steady expansion of our plastics activities. British Resin Products, Ltd., are now in regular production of polystyrene, which is sold under the trade-mark 'Distrene'. Plans are now under consideration for increasing this production in view of the proposed additional manufacture of the intermediate material, monomeric styrene by Forth Chemicals, Ltd., at Grangemouth.

Sale of polyvinyl chloride materials manufactured by British Geon, Ltd., has continued to expand and following upon the 50 per cent increase in manufacturing capacity to which I referred last year, a further extension of one-third has since been authorised and should shortly come into operation. The remarkable developments in the application of this versatile plastic suggest that still further increased production may have to be undertaken by your company in the near future.

In Australia and South Africa, our associate companies, Robert Corbett Pty., Ltd., and National Chemical Products, Ltd., have made very satisfactory progress during the past year. Plans are now in an advanced stage whereby your company's participation in the expanding industries of those companies may be substantially extended.

Last year I reported that your company had acquired a majority interest in Magnesium Elektron, Ltd. Recently we have purchased the remainder of the shares which were held by Imperial Chemical Industries, Ltd. Magnesium Elektron, Ltd., whose factory is at Clifton Junction, near Manchester, is the sole producer of magnesium metal in this country, and is to-day supplying this vital raw material for the Ministry of Materials to meet the demands of the airframe and aeroplane engine manufacturers. Use of the special new alloys of magnesium containing zirconium and the rare earth metals developed by Magnesium Elektron, Ltd., for jet engine and other purposes, has expanded steadily. Very satisfactory licence arrangements under the company's patents have been made with magnesium fabricating companies throughout the world.

Research continues to play an important part in the development of our industrial activities. The company's research is now divided between our central station at Epsom, Surrey, and out-stations located adjacent to the large operating factories.

Future Prospects

Although I have endeavoured to point out the difficulties and uncertainties of the present position, I consider it only right to tell stockholders that so far as the current year has gone the profits of the group are running at a rate in excess of those obtained in the year to 31 March, 1951.

Relationship between management and staff and employees has continued excellent throughout the year, and it gives me great pleasure on behalf of the Board to record our appreciation of the services so loyally and willingly rendered by all ranks.

The report was adopted.

Next Week's Events

TUESDAY 25 SEPTEMBER

Textile Institute

London: Gaumont British Distributors, Ltd., private theatre, Wardour Street, W.1. Film display, including: 'Plastics' (British Council); 'Discovery of a New Pigment' (I.C.I., Ltd.); and 'Science Joins an Industry' (Cotton Board).

WEDNESDAY 26 SEPTEMBER

National Smoke Abatement Society

Blackpool: Winter Gardens (until 28 September). 18th annual conference. Papers include the second Des Voeux Memorial Lecture by Dr. J. Bronowski (director, Central Research Establishment, National Coal Board): 'Power and Waste in their Social Setting'.

THURSDAY 27 SEPTEMBER

Society of Chemical Industry

London: Wellcome Research Institution, Euston Road, N.W.1. Joint two-day conference of the Food, Agriculture and Fine Chemicals Groups on 'Problems Arising from the Use of Chemicals in Food.' The opening address will be given by G. Roche Lynch, and papers dealing with preservative agents, antioxidants, flour and bread improvers, colouring matters, agricultural, inorganic and organic residues, pharmacological aspects, and legal questions will be read and discussed.

The Chemical Society

Exeter: Washington Singer Laboratories, Prince of Wales Road. Three-day conference. 'The Rheology of Films and Surfaces.' Joint meeting with the British Society of Rheology.

Royal Institute of Chemistry

Manchester: Town Hall, 7 p.m. Dalton Lecture and exhibition. Lord McGowan; 'A Hundred Years of Chemistry.'

Textile Institute

Manchester: 16 St. Mary's Parsonage, 6.30 p.m. G. T. Verral (director and chief engineer, Courtaulds, Ltd.): 'Factors in Plant Development—Production Cost Considerations in Plant Development.'

FRIDAY 28 SEPTEMBER

Incorporated Plant Engineers

Birmingham: Imperial Hotel, 7.30 p.m. Symposium of films on welding by Quasi-Arc, Ltd., Firth-Vickers, and the Aluminium Development Association.

Textile Institute

Cardiff: University, Cathays Park, 7.15 p.m. J. S. Ward (Courtaulds Dyehouse): 'Fundamentals of Dyeing.'

International Scientific and Technical Conferences

U.S.A.; Siytop, Pennsylvania. 24-26 September. American Coke and Coal Chemicals Institute, annual meeting.

U.S.A.: Ann Arbor, Michigan. 24-26 September. 5th annual conference on Administration of Research.

U.S.A.: Hot Springs, Virginia. 25-26 September. Steel Founders' Society of America, autumn meeting.

France: Paris. 24-29 September. Colloquium on 'Sensitive Emulsions and their Physical and Physico-chemical Properties.'

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APPLICATIONS are invited by the **MINISTRY OF SUPPLY** for an appointment in the grade of **SENIOR ASSISTANT (SCIENTIFIC)** at the **ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL, BERKS.,** to assist in work with high pressure apparatus, with radio-active materials, with remote handling apparatus, and with high vacum furnaces. Candidates will also be required to construct part of the apparatus used in this work.

Candidates must be at least 27 years of age and should have School Certificate with credit in at least one scientific subject, but exceptionally consideration will be given to those without such qualifications who are otherwise suitably qualified. Workshop experience including experience of construction of scientific instruments and experience in the use of scientific measuring instruments such as comparators, autocollinators and interferometers is necessary. Experience in lapping steel or glass would be an advantage. Salary £452 to £620 (men). Rates for women somewhat lower. The post is unestablished.

Applications should be made to **Ministry of Supply, Est.3.C.1., Room 829.D, Adelphi, W.C.2. quoting V.R.703 or Employment Exchange Harwell Site Office, A.E.R.E. Harwell, Didcot, Quoting Order No.185.**

CHIEF TECHNICAL ENGINEER required by the Division of Atomic Energy (production), Risley, to take charge of an engineering section responsible for all the major calculations involved in the design and construction of factories for producing fissile material. The successful candidate will be required to interpret information supplied from research sources for the engineers engaged on designing the plants.

Candidates must have either an honours degree in engineering or Corporate Membership of one of the Institutions of Civil, Mechanical, Electrical or Chemical Engineers or equivalent qualifications. They must be thoroughly conversant with the more difficult calculations pertaining to the flow of liquids in pipes, heat exchanges and other technical features normally considered to be beyond the scope of plant designers.

Salary will be assessed according to qualifications and experience within the range £1,420–£1,750 p.a.

There is voluntary superannuation scheme. Applications to: **MINISTRY OF SUPPLY, D.AT.EN (P), RISLEY, Nr. WARRINGTON, LANCS.,** stating post applied for.
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OIL Refinery Contractors handling large contracts for refinery plant require **CONTRACTS ENGINEERS** in their London office. Duties involve broad direction and co-ordination of all phases of the work, including planning, drafting, purchasing, progressing and erection. Desirable qualification is previous experience, including a wide knowledge of pumping, heat exchange equipment and instrumentation, and the appointments offer excellent prospects to suitable men. Applicants should write fully, stating qualifications, age and experience to **Foster Wheeler, Ltd., 3 Ixworth Place, London, S.W.3.**

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PAINT TESTING. **CHEMIST** required for testing paints and similar materials. Birmingham firm. Previous experience with sound knowledge to degree standard of organic chemistry essential. Applicants male or female should stage age, experience, education and salary expected. Box No. C.A. 3045. THE CHEMICAL AGE, 154, Fleet Street, E.C.4.

SENIOR SCIENTIFIC OFFICERS; SCIENTIFIC OFFICERS. The Civil Service Commissioners invite applications for permanent appointments to be filled by competitive interview during 1951. Interviews began in January and will continue throughout the year, but a closing date for the receipt of applications earlier than December, 1951 may eventually be announced. Successful candidates may be appointed immediately. The posts are in various Government Departments and cover a wide range of scientific research and development in most of the major fields of fundamental and applied science. Candidates must have obtained a university degree with first or second class honours in a scientific subject (including engineering) or in mathematics, or an equivalent qualification, or possess high professional attainments. Candidates for Senior Scientific Officer posts must in addition have had at least three years' post-graduate or other approved experience. Candidates for Scientific Officer posts taking their degrees in 1951 may be admitted to compete before the result of their degree examination is known.

Age Limits: For Senior Scientific Officers, at least 26 and under 31 on 1st August, 1951; for Scientific Officers, at least 21 and under 28 (or under 31 for established civil servants of the Experimental Officer class) on 1st August, 1951. London Salary Scales: Senior Scientific Officers (men), £750-£950; (women) £625-£850; Scientific Officers (men), £400-£650; (women), £400-£525. Somewhat lower rates in provinces.

Further particulars from the **SECRETARY, CIVIL SERVICE COMMISSION, SCIENTIFIC BRANCH, TRINIDAD HOUSE, OLD BURLINGTON STREET, LONDON, W.1,** quoting No. 3399.
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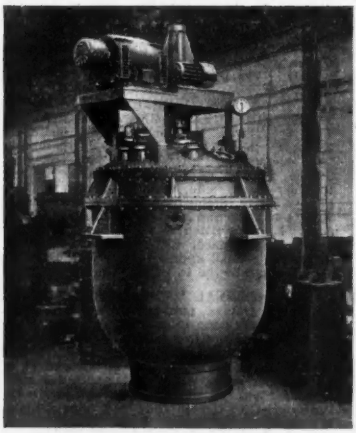

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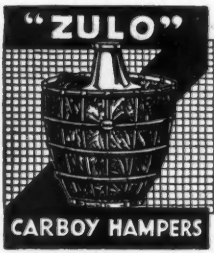

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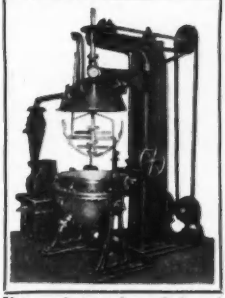

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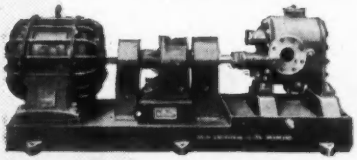

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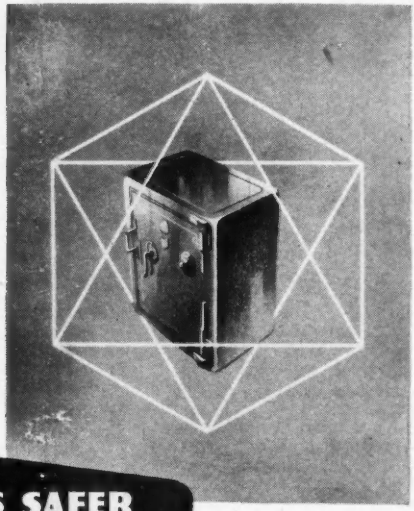

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